

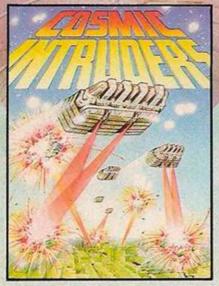


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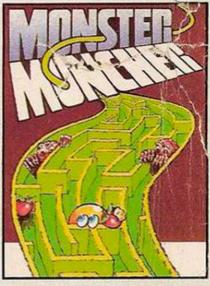
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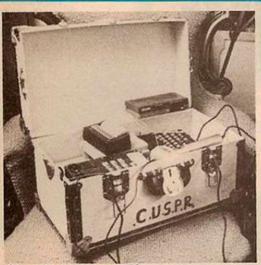
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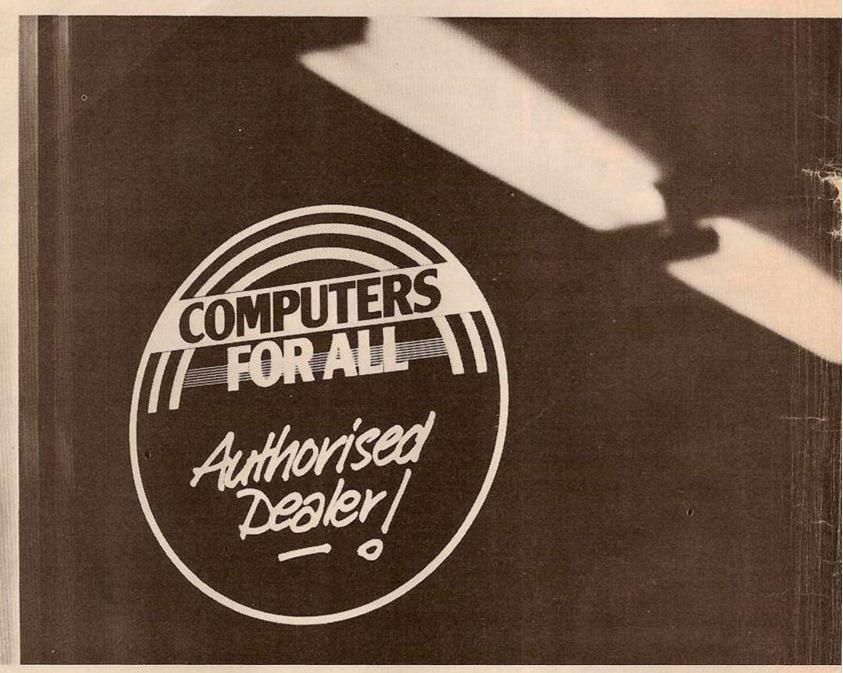
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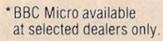
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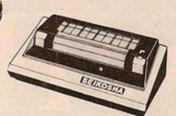
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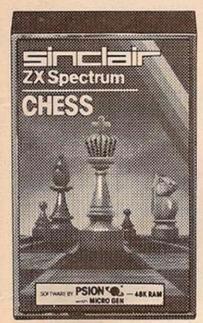
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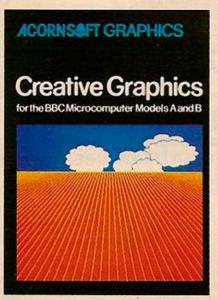
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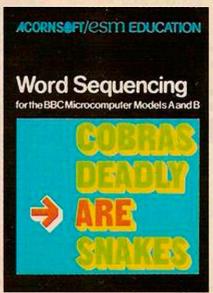
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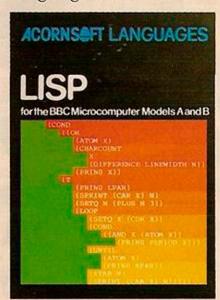


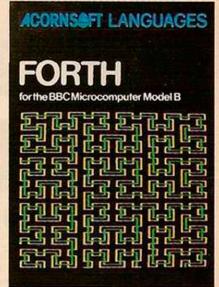


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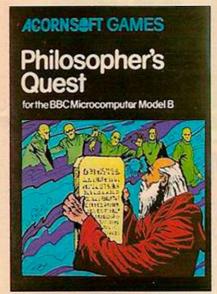
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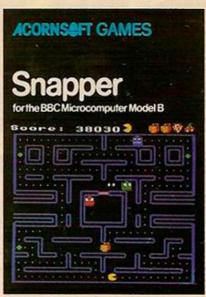
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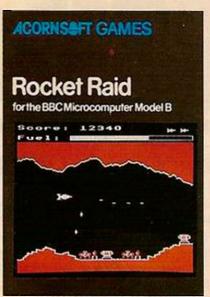
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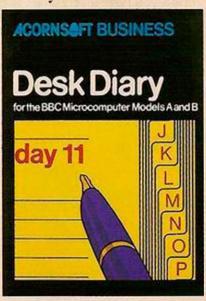
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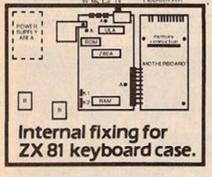
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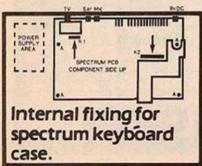
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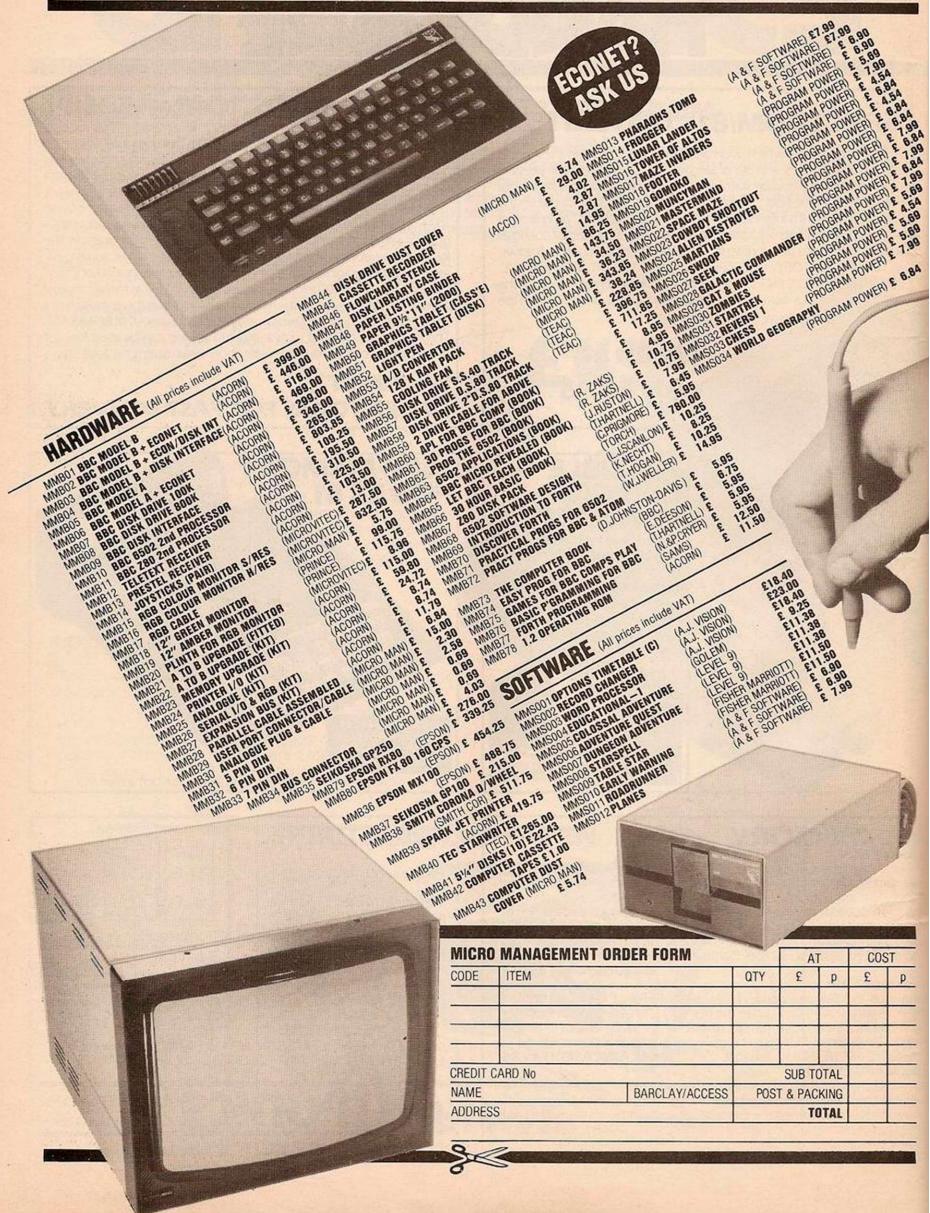
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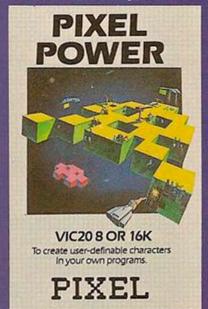
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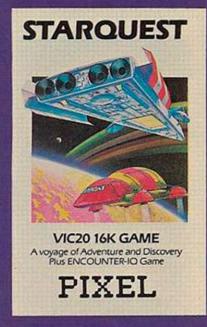
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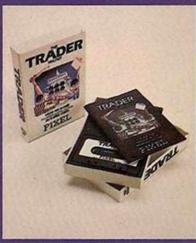
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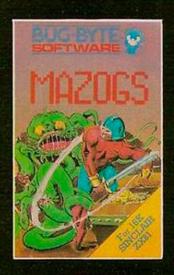
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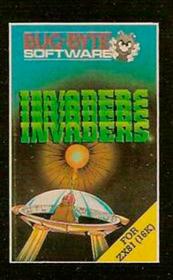
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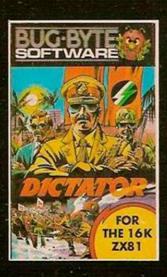
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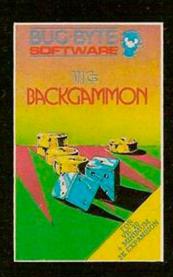


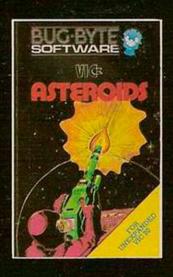


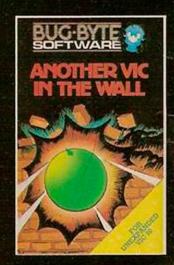






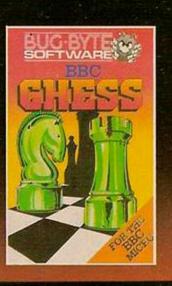










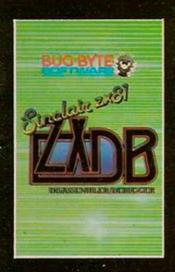




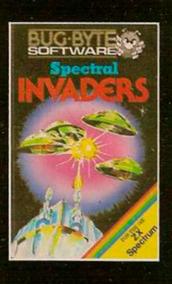




PROGRAMS THAT LEAVE NOTHING TO



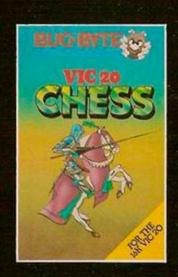


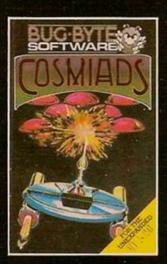




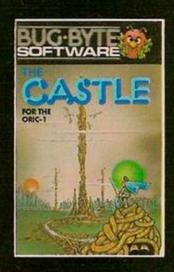


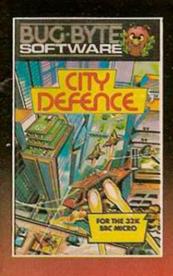
















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ditica review

66 The sound commands on the Oric 1 are, for a computer of this price, very sophisticated. Three music channels, and one noise channel, mean that you can program some fairly complex sounds. 99

POPULAR COMPUTING WEEKLY

66 Oric is everything you hoped it would be. Alive with colour, and zapping with built-in sound effects, the Oric looks like a match for any machine now selling for less than £200 99

YOUR COMPUTER

66 The 16k Oric - fighting the 16k Spectrum - is £25 cheaper. It feels a good deal more professional than the home-appeal Sinclair. Oric's sound is extremely versatile, and well up to the standard of the £300 or £400 BBC microcomputer made by Acom. 99

WHICH MICRO?

66 Oric will soon be selling a Modem so that Prestel will become available. Owners will be able to accept telesoftware programs loaded straight down the phone line eventually electronic mail could come into the home by the same route, and with the addition of a tape recorder the Oric with its Modem could become a telephone answerer and message taker. 99

YOUR COMPUTER

66 Instead of the Spectrum's 28 look-up single-character error reports. the Oric has 18 self-explanatory messages. If you actually want to do computing, rather than just exploring the world of off-the-shelf games programme entertainment the Oric will be a better buy. 99

WHICH MICRO?

66 Oric was over twice as fast as the Spectrum. Surprisingly perhaps the Oric, which initially seemed only faster when performing the simplest of calculations, has come back to beat the Spectrum by a small amount. As the problems get more complex the Oric comes into its own. One final point - in entering the benchmark tests - the Oric was certainly the easiest to handle. 99

WHICH MICRO?

66 This slope coupled with the design of the keys makes the Oric an easy machine to touch-type on. All keys have auto-repeat and there are four keys dedicated specifically to cursor control. It is certainly easier to type on than any of Sinclair's offerings. 99

YOUR COMPUTER

66 One good feature of the Oric is an on-screen reminder in the top right hand comer to show that you've engaged all-capitals mode. So much better than the BB's variety of lights in the corner of the keyboard. The Oric is sound, simple to get along with and offers great expansion potential. 99

WHICH MICRO?

66 When compared to the stogginess of the Spectrum's keyboard this is certainly an improvement. I can't see any Orics failing through bad assembly. If only the £2400 IBM were so easy to use. 99

WHICH MICRO?

66 A good speaker and built-in noises get the Oric's sound off to a good start. Typing Zap, Ping, Shoot or Explode produces convincing arcade game noises which can easily be incorporated into any program. 99

YOUR COMPUTER

66 The modern is certainly unusual in a machine of this price. Together with the other peripherals, when finally available, it should make for an attractive package for a small business...surely a match for machines costing

POPULAR COMPUTING WEEKLY

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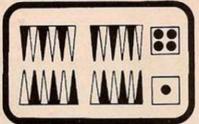
O ORIGINAL SUPERCHESS OF The Cheapest

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16k ZX81 £4.95

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SPECTRUM FORTH < O - A</p>

FORTH - 10 times faster than Basic, much easier than machine code. If you want to discover the advantages of Forth or are already converted, Spectrum FORTH is the ideal package. The package is cassette based and includes Spectrum Forth, a sample Forth program and comprehensive user documentation. It has all Forth structures and allows full use of the Spectrum's colour, hi-res. graphics. Specify 16k or 48k when ordering. 16k version, about 115 new words can be defined

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With its 10 levels of play, ZX Draughts is the ideal game for the beginner or expert player. At level 0 ZX Draughts replies immediately, at level 4 it replies in about 20 seconds and beats its own programmer, at level 9 it replies in about 13 minutes but can you beat it? Features choice of strategy and colour. Our machine code program, using tree searching techniques can analyse each position in depth making ZX Draughts a 48k Spectrum £6.95 formidable opponent.

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PROGRAMMERS - TOP RATES PAID FOR QUALITY SPECTRUM PROGRAMS SEND YOUR MATERIAL FOR EVALUATION AND PROMPT REPLY

MEN WHO INVENTED CLEVER ENOUGH TO MAKE THINK MF FORTH' (IT'S 10 TIMES AND TIMES MORE COMPACT THAN 'BASIC').

YET THEY'RE DUMB ENOUGH TO SELL ME FOR £89.95!

Jupiter ACE

Richard Altwasser and Steven Vickers are the men who invented the Jupiter Ace.

After years of designing microcomputers that use BASIC (both men played a major role in creating the ZX Spectrum), they abandoned it in favour of FORTH.

FORTH is just as easy to learn as BASIC. Yet it's a faster, more compact and more structured language that educationalists and professional programmers alike prefer.

So the Jupiter Ace is the only microcomputer you can buy that is designed around FORTH.

Using it, there's little fear of accidentally 'crashing' programs halfway through and having to start all over again (a common fault with BASIC). The Jupiter Ace's comprehensive error checking sees to that.

The Jupiter Ace has a full-size keyboard, high resolution graphics, sound, floating point arithmetic, a fast, reliable cassette interface, 3K of RAM and a full 12 month warranty.

You get all that for £89.95. Plus a mains adaptor, all the leads needed to connect most cassette recorders and T.V.'s, a software catalogue (35 cassettes available, soon to be 50), the Jupiter Ace manual and a free demonstration cassette of 5 programs

The Jupiter Ace manual is a complete introduction to personal computing and a simple-to-follow course in FORTH, from first principles to confident programming.

Plug-on 16K and 48K memory expansions are also available, at very competitive prices. (There'll be a plug-on printer interface available soon, too.)

It'll take you no time at all to realise how clever Richard and Steven were to design the Jupiter Ace around FORTH. And even less time to realise what a silly price £89.95 is to charge for it.

Technical Information

Hardware

Z80A; 8K ROM; 3K RAM.

Keyboard

40 moving keys; auto repeat; Caps Lock.

Screen

Memory mapped 32 col x 24 line flicker-free display upper and lower case ascii characters.

Graphics High rocal

High resolution 256 x 192 pixel user defined characters.

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YOUR LETTERS

SPECTRUM TV PROBLEM

any Spectrum owners have not been able to obtain a colour display on certain colour televisions. They have a sharp monochrome display at one position of the TV tuner and distorted colour display at another. My solution is as follows: First, remove the five screws from underneath the casing and turn the computer upright; then carefully lift the top part of the casing so that it is just clear of the circuit board. Move it down over the rest of the casing taking care not to tension the keyboard ribbon cable.

Between the ULA and PAL encoder - see introductory manual page 29 - you will find four adjustable screws. These are used to tune the two separate outputs of the ULA which are related to the contents of the display file and the colour attributes. Next, connect the computer to the television as normal and create a colour display, for example

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Note carefully the initial positions of the screws mentioned previously. Using a screwdriver adjust the top three of these screws until the colours appear on the display, starting with the resistor marked 2.2Kr. If after a period of time the colour disappears then further adjustment is needed. The bottom screw may also be adjusted if necessary. If this procedure fails then return the screws to their original positions. Finally, reassemble the casing, turn over and replace screws.

These alterations are both simple and perfectly safe and should put life into many a Spectrum display.

Mark Nolan, Malahide, Dublin.

MAZE CRAZE

number of people seem to have had a problem with Maze published in the March edition of Your Computer The misunderstanding probably lies in line 5008, which reads

5008 LET d\$ = "1 <>v"

The string in this line should contain four characters - up-arrow, less-than, greater-than and lowercase v. The symbol in the middle is not the Sinclair unequal sign, although the two look the same on

In addition, it is worth typing Clear before saving the final version on tape - this prevents all the variables being dumped on to cassette.

> Colin Carruthers, Edinburgh.

THE CURE

built my ZX-81 from a Sinclair kit. After some teething troubles I had about six months of daily use without a hitch. Then the loading problems started. It was hit and miss, the trend became an increasing number of missed loadings. Something had to be done.

All the favourite cures had been tried, different volume settings; cleaner tape passed through; different types of tape; clean heads with meths and cotton wool buds; developed eye ache looking at loading patterns on the screen in an endeavour to interpret them; purchase and use of head demagnetiser.

It may sound silly but I suspect that many other computer "nut ' are also guilty of not using the Tape Recorder for the purpose for which it was intended. During a bout of frustration I listened to one of my favourite recordings and there was a lot of background hash. At first I accepted the poor signal/noise ratio as the quality standard of the recorder. But I became sure that the recorder did a better job some months ago. What if the computer was upset by this hash? I rooted out a capacitor substitution box and connected between the Ear input and earth of the recorder. The best de-coupling value was found by a marked reduction in the noise.

I obtained a suitable capacitor and soldered it into the recorder. That was over six months ago and loading has been no problem.

G Winterburn, Lytham, Lancashire.

SINCLAIR TRICKS

have found out three things which may prove useful to Spectrum owners. The first is how to break into programs, which upon loading jump to some machine code. Type in the following. 999 Merge "" STOP

Load in the program, and when the loading is completed, the computer will display a Stop error code. You now have access to the program. The second, and most useful thing I found out, is how to disengage the

The trick in doing this, is to Poke down the screen to 24 lines deep at the beginning of your program. At any attempt to break into the program the screen will fill, and the computer will get lost in an endless loop. This happens because when the Break key is pressed, an error code appears. As the computer is used to printing on the bottom two lines, it will not like it if the two in a crash.

If at any time in the program you do need to re-engage the Break key, include a line which Pokes back to two lines. The pokes are as follows:

POKE 23659,0 disengages POKE 23659,2 re-engages

The third thing I found out is how to print on the bottom two lines. The function "Print # 1; "Hello" will print hello on the bottom two lines. This is best demonstrated by typing in this short program.

10 Print # 1; CHR\$ (RND*127+33):

GOTO 10

Random characters could be printed on the bottom two lines. As the text goes over the line, the area expands to three lines, then to four, and so on. The machine code equivalent of this instruction is RST16, which prints the CHR\$ of register A. I hope these few tricks will prove handy to Spectrum owners.

DJ Whale, Harlow, Essex.

BBC MONITOR

ichard Harris's monitor program for the BBC Micro published in March Your Computer is excellent but happens to have one mistake. The label

650 .back DEC 8:80

The monitor can be further enhanced by printing the ASCII values when listing an eight-by-eight block and this is achieved by changing the following lines.

40 data1 = P\$ + 965:data2 = P\$ + 1120: data3 = P\$ + 1275

50 mess = P\$ + 1430:XYmess = P\$ + 1645:pmess = P\$ + 1680

60 data4 = P\$ + 1685:sptab = P\$ + 1755 REM SET BASE ADDR OF DATA

These lines create the extra space required for new code inserted to print the ASCII values in block print. Following additions are required to achieve this. Replace lines 920 to 1110 with the following: 920 block

930 LDA #8 940 STA &82 950 LDY #0

960 .cd LDX #8

970 STX &83 972 LDA 880

973 STA&84

974 LDA&81 975 STA 885

980 JSR newlin1

990 JSR addrpr 1000 .bc LDA (880),Y

1010 JSR print

1020 LDY # 1

1030 JSR space 1040 INC 880

1050 BNE ab

1060 INC 881 1070 .ab DEC &83

1080 BNE bc

1081 LDX #8:STX &83:LDY #2:

JSR space 1085 .bf LDA (&84),Y:CMP # &20: BCC bw:CMP # &7E:BCC br

1086 .bw LDA # 82E

1090 .br JSR &FFEE 1091 INC 884

1092 BNE bh

1093 INC 8:85

1094 .bh DEC 883 1095 BNE bf

1096 DEC 882

1100 BNE cd 1110 JMP ff

Finally change lines 2430 to 2440 to: 2430 .newlin:JSR &FFE7

2440 .newlin1:JSR &FFE7:RTS

These changes will allow the user to locate data areas easily and will also help him to look more closely at the BBC OS and Basic Roms. I hope other users find these changes of use.

Deepak Laxman, Godalming, Surrey.

DEFENDING TIM

n response to A Jaques' letter -March edition - Mr. Hartnell was merely pointing out various ideas which the reader may put to good use.

Perhaps if Mr. Jaques had spent many hours of his valuable time writing programs he might understand what piracy can do to a company: his attitude typifies the person who simply wishes to have endless hours of fun without giving those who make it possible their just

NOSTALGIA AND PROGRESS

Phank you for your timely words of wisdom in the March issue editorial in respect of the current low-price computer war. I own a UK-101, and over several years have upgraded it to 32K RAM, 16K ROM, a multi-dimension screen format including a useful 32 × 64, 8912 PSG, a PIA, VIA etc, with the inclusion of the Cegmon screen editor and machine-code monitor. I was beginning to develop an inferiority complex being restricted to block graphics only. As a matter of interest I ran the speed program in the Oric versus Spectrum article and was pleasantly surprised to achieve Load Array and Sort Array times of eight and 190 seconds respectively taking up 225 bytes of program space and 4041 bytes of variable space. The machine runs at 1Mhz which can also be upgraded.

Instead of buying one of the new plastic-case tortoises I will now return to my steel-clad monster - although not up to the size of the Manchester Mark I computer - and build a high-resolution and colour board with its own RAM leaving me with a full 32K memory less workspace - about 770 bytes - while I wait for the "ultimate" computer.

N L Smith, Stoke-on-Trent, Staffordshire.

reward. If Mr Jaques would look in the March 1983 Response Frame he would see there a letter written by someone who had tried to break into a program to copy it.

I regard Your Computer as the most user-friendly magazine available and quite simply the best at helping the user in trouble. Perhaps if Mr Jaques had experienced loading and output problems and suffered the frustration of it all then he would understand how valuable a service Your Computer is. I did not find any points technically related to a machine in Mr Jaques' letter.

Michael Gregory, Guisborough, Cleveland.

BELGIAN VIC

iving in Belgium, I am the proud owner of a Vic-20. When attempting to load a program from cassette, it can be very helpful to listen to the cassette signals. This can be achieved by simply connecting a standard earphone to the Vic's cassette connector. It does not need an amplifier and cannot damage your Vic at all. Just connect the earphone leads parallel on pin A1 - ground - and pin D4 - read - of the cassette connector. See the user manual on page 151 for the pin configuration. Once connected you will both hear the loading and saving of your programs.

The synchronising header, checks, um, bytes and double storage are three good error-checking techniques used by Commodore to make their tape system very reliable.

Manuel Allaert, Ostend, Belgium.

FAST GRAPHICS

apologise to readers using the machine-code routine described in my article on fast animated graphics for the Spectrum who have found that it does not work correctly when "Width" is greater than 16-bits. The culprit is a missing instruction LD (IX+9), 8 which should come between the instructions EX HL,DE and LA DEC (IX+8) in listing 3. If you have your original version of the machinecode routine "Animate" on tape, then you should obtain a corrected version as follows: reset RAMtop to 65159 - 48K - or 32389 - 16K with the appropriate clear command. Load your old version of "Animate"

Enter and run this Basic program: 10 Let A = 65160 (32390 for 16K)

20 POKE A + 158, 24 30 POKE A + 159,37

40 FOR B = A + 197 TO A + 204 50 READ C : POKE B, C

60 NEXT B

70 DATA 78, 235, 221, 54, 9, 8, 24, 211 80 SAVE "ANIMATE" CODE A, 205

Robert Newman, Oundle, Peterborough. EDITORIAL

YESTERDAY YOU WERE impressed by your bargain buy - £200 for a whole microcomputer. Today the smile of the proud new owner fades on your face as you see the same machine at the revised official price of £150. You rush to the calendar: it's too early for the summer sales, and April Fool's Day is long past. Then you recall something you read in last month's Your Computer: a Commodore spokesman, when asked to deny persistent rumours that new technology makes the £350 Commodore 64 cheaper to produce than the old £130 Vic-20, would only say that price "was all to do with what the market will bear - not to do with what it costs to make".

This is a clear statement of fact and nothing which should astonish or outrage us. After all British motorists have to pay more than the rest of Europe for the same cars.

Why then should we be surprised to learn that in the vast U.S. market, the ZX-81 - or Timex 1000 - can cost as little as £36 even though most Americans have larger disposable incomes, that the Stateside Spectrum is less than £100 for a machine with a higher specification, and that similar stories can be told about Ataris, TI-99/4s and any other micros you care to name?

You remember being told and not believing that the components inside a Spectrum could cost Sinclair as little as £15 and you begin to wonder if the £50 price cut after you bought your micro could just as easily have been £75 or perhaps even £100.

Before writing off micro pricing as a black art, you should understand how it works. Prices drop because products are in competition with newer or cheaper technology. If a micro-maker has the skill | computing to fill the breach.

to be first on the market with a new kind of product, that company can inflate the asking price to as high a level as it believes the market will take. Then, as the competition arrives to share the pickings, the first company will deflate the price to try and increase the volume of sales and so maintain or even improve profits.

As the market grows, production costs tumble partly because the more integrated circuits the chipbuilders produce, the smaller the percentage of faulty circuits - and that means increased yields and lower unit costs. Of course you can come a cropper if the original price is too high. The excellent TI-99/4 was the first 16-bit colour home micro and cost about £750 when it was introduced in 1980. As other machines appeared, the TI-99/4's price had to be dropped progressively to its current level of £150 to remain competitive with the newcomers. Some would argue that its original price asked too much of the U.K. market and damaged the micro's prospects in the long run. A £350 price tag for a machine of such a calibre in 1980 might have given the TI-99/4 a vast user and software base in Britain.

Clearly there are concealed costs beyond the price of components. Companies have to allow for research and development, labour, production overheads, packaging, distribution, marketing, margins for retailers and even the expense of maintaining the jammed switchboard of the customer complaints department. But when you add all that up, the gap between costs and price can still be very large. Perhaps that explains why so many new companies are bravely rushing into

How to write for Your Computer

We called this magazine Your Computer precisely because we welcome your views, tips and hints and even your criticism of machines and software in general. If you would like to see your name in print, whether on a Software File program or a full-blooded article, here is how to go about it. Ideally, all articles should be typed double-spaced on one side only of uniform sheets of paper. If listings can be dumped directly from a printer — you can always use a friend's or user group's this minimises the risk of error. In a perfect world a cassette would accompany the article. That considerably speeds up the checking process. Not only do you get to air your own discoveries and opinions, but we will even pay you for the privilege. We pay £35 per published page - that's as it appears in the magazine and includes illustrations.

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Premier disc system – a first for Dragon 32

Now THERE IS a disc system for the Dragon 32. Premier Publications has incorporated a Disc Operating System and disc controller in a single cartridge which plugs into the games cartridge port.

The Disc Operating System supplies a comprehensive set of commands which appear to the user as an extension of Basic. As well as standard facilities for creating and deleting files, reading the directory, disc formatting, renaming files, there is also provision for opening up to eight random and sequential files simultaneously.

Two unusual features are the Find and Config commands. Find enables data files to be searched for a string match. Config allows the user to configure the system to run with

Millionth U.K. micro sold

THE END OF APRIL marks a milestone for home computing — with the sale of the home computer in Britain. There are more ZX-81s out there than anything else followed by Spectrums, Vic-20s, BBC Micros, Dragons, TI-99/4s and a dozen other computers.

BBC Music Processor

QUICKSILVA MUSIC Processor turns your BBC Micro into a tape recorder and synthesiser for just £14.95, Andy Williams the author of the program, started working on it in May last year. He says that if he had worked full time it would still have taken him six months to complete.

Business Press

THE NAME of Your Computer's parent company has been changed from IPC Business Press Ltd to Business Press International Ltd. This change has been made to reflect the very wide range of markets covered by the 100 publications of the company, and to identify its prime position as the world leader of business publishing.

almost any type of floppy-disc drive available. The number of tracks, sides and sectors per track on a disc can all be specified to allow the system to support 3, 5.25 and 8 in. drives. In addition the controller cartridge can cater for up to four drives at a time, in any combination.

The cartridge comes with a 74 page manual and costs £99.95. Premier Publications is also selling complete systems, starting with the Delta 1 at £299.95.



This includes the controller, Croyden Rocables, and a 40-track Canon disc drive with a capacity of 100K. SE20 7YX.

Premier Publications is at 208, Croyden Road, Anerley, London SE20 7YX.

Spectrum goes organic while ZX-81 grows to one megabyte

THIS MONTH Basicare is releasing an interface which will enable Spectrum owners to use most of the modules in the company's Organic Micro system which is now available for the ZX-81.

These include a CMOS RAM module backed by battery for non-volatile program storage, Toolkit, an interface to take up a 8K of utility programs stored in EPROM or ROM, and a sound synthesiser module. There is also a general purpose interface providing 24 input/output lines and a Centronics interface to link the ZX-81 or Spectrum to most printers.

On the ZX-81 the printer

interface is accompanied by a program which prints ZX-81 graphic characters on Epson and Seikosha printers.

The modules can be stacked on

top of each other and are interfaced to the computer through the Persona module which communicates with the other devices via a 64-way bus.

One feature that sadly will not be available for the Spectrum is the Minimap module. This enables ZX-81 owners to access up to one megabyte of RAM. Only 64K can be read at one time but up to 16 pages of 64K can be switched in and out using a single Poke instruction.

Analogue to digital, and digital to analogue converters for both the ZX-81 and Spectrum will also be released. Future developments include a joystick controller and a fast cassette loading device.

The Personal module costs £30.25 and the Minimap £35.95. Prices for the other devices range from £22.20 for Toolkit to £76.25 for 64K RAM. Basicare is at 12 Rickett Street, London SW6. Tel: 385 2135.



Spectrum owners can now link their micro up to the £149 Tandy colour

printer. Softest is selling an interface package for £35. It includes the

necessary hardware together with cables and three programs which allow

user to access the Tandy printer commands. A high-level driver program

to make graph plotting easier is under development and will be available

for £5.00. Softest is at 10 Richmond Lane, Romsey, Hampshire, SO5

Ikon's Hobbit for the BBC Micro runs rings around conventional cassette storage

YOU'VE READ THE BOOK, you've seen the film, now buy the floppy tape drive. Hobbit is the name of a new storage unit for the BBC Micro which is faster than cassette and cheaper than disc storage. It reads and writes at almost seven times the rate of the standard cassette, and also offers many of the housekeeping facilities of a disc system.

Ikon Computer Products, which makes the Hobbit is supplying it with an EPROM which contains the floppy tape equivalent of a disc-operating system and takes care of such tasks as locating a program on tape and updating a directory. All of the standard BBC file

commands are supported as well as a few extra commands which are specific to the Hobbit.

The Hobbit has similarities to Sinclair's Microdrive but whereas the Microdrive will use a continuous loop of tape, tape on the Hobbit can be moved backwards and forwards. The average access time is 20 seconds with a maximum of 90 seconds.

Two drives can be connected to the BBC through the user port. Each takes a cassette with a capacity of 60K per side.

Perhaps Ikon should have considered calling the £155 Hobbit after another furry animal - the rabbit in Magic Roundabout - because Ikon is home of Dyan Thomas.



based at Kiln Lake, Laugharne, Dyfed - which used to be the

80K for £300 coming soon

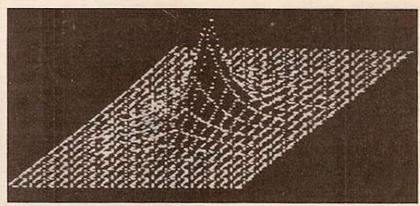
LATE NEWS of an ! 1K home micro about to be announced by one of the world's biggest micro makers. The machine will set new standards in BBC Micro, Commodore 64 country and will cost around £300. More details next month.

High resolution Sinclair tape from self-taught schoolboy

RICHARD TAYLOR, a 14-year-old schoolboy, has found a way to improve the ZX-81's 64×44 pixel resolution without using any extra hardware. Until now high resolution on the ZX-81 could only be obtained from high-res graphics boards costing over £50. Richard Taylor's program, High Resolution, comes on a cassette and gives a resolution of 256 by 192.

The program takes up around three-quarters of a K and creates its own display file which consumes a further 6K. It allows you to plot points, invert points, save and load a high-res picture, and also to define new characters.

Like most of the other programming whizzkids Richard Taylor is entirely self-taught. He finds rewriting the operating system easier than devising games. "There is no point in



doing what everyone else is doing", he explained and added "I like to make a machine do what it's not designed for". He has now moved on to the Spectrum and is working on a

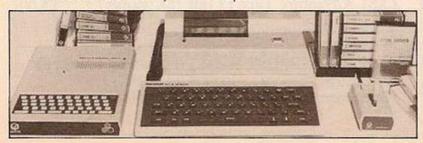
program to give the Spectrum a genuine 36 colours.

The High Resolution program costs £5.95 and is available from Computer Rentals, 140 Whitechapel Road, London E1.

Android Attack on the trail of Dragon Donkey King

FLUSHED WITH the success of its | top-selling Dragon program

Remember the MPF II - the £269 colour computer we scooped last October? At the time our reviewer complained that it was a good machine let down by a dreadful keyboard. Here it is with the £36 full-size keyboard. joystick, £185 thermal printer and some software all of which are now available all over the country from the Spectrum dealer chain.



Donkey King, Microdeal has now released five new programs for the Dragon. Android Attack is based on the arcade game Beserk, includes some limited speech synthesis and routinely announces intruder alert or charges the player with cowardice. Galactic Ambush and Cosmic Zap are Microdeal's versions of Galaxians and Space Fortress. Program packs 4 and 5 each contain nine short programs. These tapes are available from Microdeal and Dragon dealers for £8 each.

Company Machine Arcadia Spectrum Imagine **■** Choplifter Software **■**Choplifter Broderbund Atari **■**Donkey Microdeal Dragon King **■** Dragon Dragon Flight Psion Spectrum Simulation Flight Psion **ZX81** Simulation **■** Hobbit Melbourne Spectrum House ■Kong/ **ZX81** Dracula Barber ■Moons of Romik Vic-20 Jupiter Penetrator Melbourne Spectrum House Planet Microdeal Dragon Invasion ■ Rocket Acomsoft BBC Raid Sea War Panda **ZX81 ■**Synapse Fort Atari Apocalylpse ■ Snapper Acornsoft BBC Quicksilva Spectrum Time Gate **■3**D New Defender Generation Traax Llamasoft Vic-20

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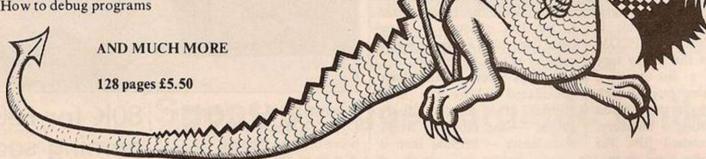
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Full explanation of all Graphics commands with worked examples

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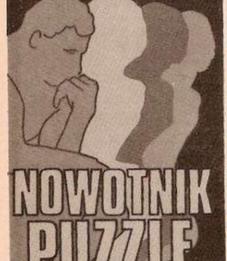
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For either the 16K Spectrum or 16K ZX81, this is an original challenge for anyone. The screen becomes the playing board for this addictive puzzle. Machine coded for smooth and instant responses, it offers four levels of difficulty. The com-puter breaks and shuffles a two-by-two coloured square have you the skill and mental agility to restore it? "Very addictive" - ZX Computing Feb/March 1983.

ZX SPECTRUM

Knight's Quest (48K) £4.95 Nowotnik Puzzle (16K)



A full-blooded adventure for the 48K Spectrum using splitscreen graphic pictures and a scrolling text window. You must find Merlin's lost treasure, battling elves, scorpions, dragons; rescue a princess from the evil Wizard of Trill - it goes on and on! Over 120 locations plus a full English command line scanner, machine coded for fast recognition. Truly state-of-the-art! Also available for the 16K ZX81.

ZX81

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Dept A FREEPOST EM463 (No stamp required) 99 East St, Epsom, Surrey KT17 1BR. Telephone 03727-21215. 24hr phone service.

A DAWN CROSS-COUNTRY DASH | from Littlehampton on the Sussex coast to Your Computer's offices on the outskirts of London just failed to clinch first prize in the £3,000 Castle of Riddles competition for 34-yearold company director Colin Bignell. Only 20 minutes before Colin Bignell's car drew up outside the Your Computer headquarters, Peter Voke of Aylesbury, Buckinghamshire was safely delivering the winning entry into the hands of editor Toby Wolpe.

Third past the post was Peter Colbert, a Cardiff-based British Telecom programmer. He put his faith in his colleagues at the Royal Mail and entrusted his entry to the vagaries of first-class. He had solved the riddles in six hours — two hours faster than the other prize-winners. Both he and Colin Bignell each receive £400 of Acorn equipment, while Peter Voke won the £700 silver "King of the Ring" trophy and £1,500 of Acorn hardware.

At the top of his shopping list is a dry ink-jet printer, followed by a small disc drive and a

Acornsoft Castle of Riddles: the knights errant receive rewards



From left: runner-up C P Bignell; Your Computer editor Toby Wolpe; winner Peter Voke; Acornsoft's David Johnson-Davies; and in third place P K Colbert.

second processor. The two runners-up have set their sights on disc drives, although Peter Colbert also finds the voicesynthesis chip a very attractive proposition. His six-hour session that solved the Castle of Riddles started on a Saturday morning

and ended early in the aftrnoon of the same day.

Although the cassette had arrived two days before, his wife was against his spending all night at the keyboard.

Away from the cut and thrust of the world of adventures, "King of the Ring" Peter Voke confides that time spent away from the keyboard and, above all, moderation are his keys to success. He recommends sleeping sensibly — would-be champions should note that throughout the time he was wrestling with the Castle of Riddles he made sure he got his 10 hours a night.

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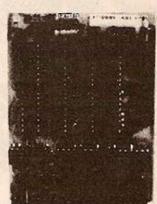
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COMPUTER CLUB_

Computer Club is here to encourage you to start your own local computer club or, if one already exists, to join it and become involved. We would like to hear of anything which has made your club a success, or of any projects or programs you are developing.

RMINGHAM CALLIF

Birmingham is not only the venue for our Midland Computer Fair at the end of April - it is also the home of a computer club which can be heard broadcasting on local radio. Simon Beesley tunes in to West Midlands Computer Group.

FOR A SMALL club the West Midlands Computer Group is remarkably productive. It puts out a monthly magazine, Databus, has its own 15-minute slot once a week on Radio West Midlands, and also produces its own software. Databus packs into 10 pages a useful mixture of news, articles, programs, programming and software reviews - all contributed by club members.

The driving force behind the club is David Thomson who founded it last August. He teaches at a local school and was initially concerned to provide a forum for the computing interests of pupils once they had left school. He was assisted by three of his expupils in setting up the club.

The three in question are all talented programmers and are considering marketing their software. With the present boom in commercial software sales no doubt it will not be long before they are rubbing shoulders with the Bug-Bytes and Quicksilvas of the business. Your Computer - ever quick to spot new talent - can boast that we gave one of them, David Griffin, his first break when we



published his game Maze Munch in our December issue. This program for the BBC Micro was one of our most popular and as an amateur programmer myself I was rather disconcerted to learn that it had taken David Griffin just one hour to write.

From its connection with David Thomson's school the club has now broadened out and, according to Databus, includes no less than three astronomers among its 36 members. One of the astronomers uses a ZX-81 to control the movement of his telescope.

Most of the machines in evidence were BBC microcomputers. Holding its own with the BBCs was a customised ZX-81 in full concourse trim, complete with an add-on keyboard, a wooden casing, a Qsave tape-loader and Atari joysticks.

David Thomson suggested that one of the reasons for the BBC Micro's popularity among computer club enthusiasts was the extensive facilities it offers for communicating with the outside world. His own interests are concentrated, as he put it, on the back of the computer and he writes a regular series in the club's magazine on control applications.

At this meeting he demonstrated how to write to the user port on the BBC. Another member had brought along a board fitted with LEDs which plugged into the user port and showed which control lines were in operation.

Elsewhere in the room David Berry, the club's ZX-81 expert, turned his hand to showing a beginner how to write the software which would read joystick inputs on the BBC.

Another group was taking an unconventional approach to adventure games. One of the members had cracked the code which Acornsoft adventure programs use to store their phrases and sentences. He had with him printouts of all the responses that the computer could give in the Castle of Riddles and Philosopher's Quest - a philosopher's crib sheet.

As can be seen, within an informal framework, the West Midland Computer Group's activities are varied and enterprising. The club meets once a month in the Victorian splendour of a room at Birmingham's Central Hall. For more details you can contact David Thomson on Bromsgrove 32242.

Local society news

Basildon buffs

THERE is now a microcomputer club for the Basildon area. It meets fortnightly on a Tuesday evening at Healey Management Services, The Hemmels, Laindon, Essex. You can telephone Roger Sims on Wickford 63032 after 6.30pm.

Thurnscoe micros

AROUND 70 people attended the first meeting of the Thurnscoe and District Microclub in March. Not all were owners but a straw poll revealed interests in a wide range of machines, from the Spectrum and the Dragon to the Pet and Nascom III. Meetings are held every Wednesday evening at Thurnscoe Comprehensive School, Clayton Lane, Thurnscoe, South Yorkshire. For further information contact Peter Davis on 0709-893880.

Liverpool users

SINCLAIR owners in Liverpool can attend meetings of the ZX Users Club every Wednesday evening at the ZX Computer Centre, 17 Sweeting Street, off Castle Street, Liverpool 2. Anyone is welcome whether they have software or hardware problems, an interest in programs and games, or just a general interest. More details can be obtained from Keith Archer on 051-260-4950.

Enfield brigade

ENFIELD Computer Club caters for the novice and expert alike. Meetings are held on the first and third Monday of each month at Brigadier Youth Centre, Brigadier Hill, Enfield, Middlesex. The annual membership fee is £2 and a further 25 pence is charged at each





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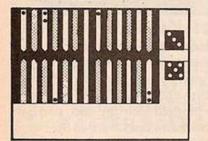
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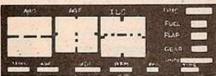
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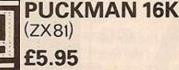


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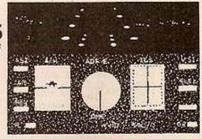
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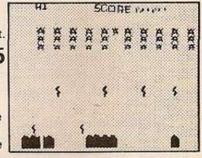
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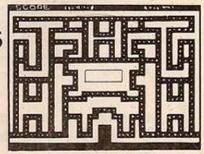
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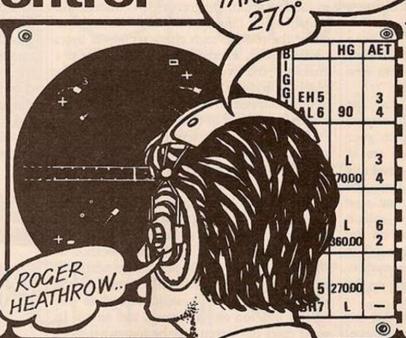
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FIRST BYTES.

'What does the term memory-mapped mean? I have seen it used to describe screen displays on computers.'

YOU CAN THINK of the computer's memory as being composed of a series of boxes. Each box is a memory location and can hold a number between 0 and 255. One area of memory — usually either 8K or 16K — is set aside for the computer's read-only memory" — ROM — which contains the system that allows the computer to interact with you, do calculations, put things on the TV screen, and so on. This area can only be read from, so it is rather like a jar with a lid on because you can see what is inside, by Peeking, but you cannot put new information in — that is called Poking.

One further area is reserved for the information which is displayed on the screen, and it is this area that you refer to in your question. The locations in this case are in "random access memory" — RAM — and this means that information can be read from and written to them. So you can both put new information in these locations — which amounts to putting new information on the screen — and see what is there. The computer's electronics translate the numbers in these locations into what will appear on the TV screen.

Now, there are two ways in which this can be done. If you have a ZX-81, for instance, you will find that the screen RAM — often called the Display File — contains the Codes of the characters which are to be put on the screen. It does not hold information about each and every dot — or pixel — on the screen.

This may be called a character-mapped screen. Before printing a character the computer needs to consult a section of ROM known as the character generator, which stores the dot patterns for each character.

On the other hand, owners of machines such

Starting out in home computing? First Bytes is for you.

Just write to Your Computer with any hardware or software problems, no matter how small or simple.

QUESTONS What is a memory map?

as the Spectrum, Dragon or BBC Micros will find that the Display File holds information about the rows in each character — the bytes on the screen, where there are eight bytes to a character and every byte is eight dots — or pixels — wide. This is sometimes referred to as a bit-mapped screen since each pixel on the screen is assigned to a bit in memory.

If your computer's screen is truly memorymapped this will mean that there is a set, unmoveable area of memory put aside by the micro. In the case of a character-mapped screen about 700 locations are reserved, and for a bit- or pixel-mapped screen the area will be at least eight times as large.

The number stored in the first location in the screen RAM usually determines what will appear in the top left-hand corner of the screen, the second location relates to the second position on the screen, and so on. In some cases the screen may be somewhat more complicated than this — as owners of the Spectrum may have discovered.

Sometimes, however, a computer will not set aside a fixed area but will instead keep enough locations free somewhere within its RAM — with a pointer to the start of this area being kept in a known place. In othr cases, and Camputers' Lynx is one example, the screen's memory may be quite separate from the RAM which is available to the programmer. In such cases the Display File may be in separate

memory chips which cannot easily be read from or written to.

Lastly, some micros put aside a varying amount of memory for the screen depending on whether a text or graphics display is chosen. This may amount to your having the choice between a memory-frugal Text mode and a memory-consuming Graphics mode—the Oric 1 and Dragon 32 are just two examples here.

Tim Langdell

BEATING PUT A REM

ONE OF THE advantages of writing your own programs, as opposed to typing other people's in, is that at least you know what the machine is meant to be doing — so debugging certainly should be easier. But it is amazing how quickly you can forget what a particular bit of code is trying to achieve.

One of the most powerful weapons in the debugger's armory turns out to be the lowly Rem statement.

This is very useful if it merely tells you what

I could do that...

Amstrong numbers are numbers that are equal to the sum of the cubes of their digits. For example, 371 is an Amstrong number since $371 = 3^3 + 7^3 + 1^3$. Write a program to output all the Armstrong numbers between 1 and 5000.

We were a month early in picking the winner of March's competition in April. Future First Byte competitions will be judged two months after they are set an closing date for entries is the last working day of the month in which the competition appears.

KEYINGIN

ALL VERSIONS of Basic allow you to enter information from the keyboard with Input. When Input is reached the program waits for you to enter something before continuing. It allows you to enter several characters at the same time and edit them before Input, but has the disadvantage that you must always follow your last character with Enter, which is slow and can be a nuisance when you only need to use a single key in both games or serious programs.

The alternative way of getting information from the keyboard, which is found in many Basic dialects, is the Inkey\$ function. This can continually scan the keyboard and tell you instantly when a key is pressed. Inkey\$ is also particularly useful in high-resolution graphics modes as it does not send you striaght back to the normal text screen as Input does. As the program does not automatically stop and wait for you to do something a loop must be made

around Inkey\$ which is only left when a key is pressed:

10 A\$ = INKEY\$ 20 IF A\$ = "" THEN 10

Note that Inkey\$ always gives you a String variable, and that the sign for an empty string is double quotes and a full stop.

If you want to enter a number and use it for calculations then you must convert the string into a numeric variable with the Val function:

30 A = VAL(A\$)

If you want to use cursor keys to continuously control left and right movement you can convert the Inkey\$ string to its ASCII value — 8 for left and 9 for right — and then simply add on the left and right movements to the current position:

30 A = ASC(A\$)

(or A = CODE(A\$) on Sinclair)

40 POSITION = POSITION + ((A = 8)-(A = 9))

Keith and Steven Brain

FIRST BYTES.



Lynx winner, Dave Bull giving his two-year-old son early keyboard experience. Competition details on page 183.

Relational and logical operators may sound awesome, but a computer would be lost without them. Here we explain them as simply as possible.

ALL ABOUT OPERATORS

A COMPUTER CAN only tell the difference between off and on. Sitting on the fence is not possible. It is therefore totally logical in the way it makes decisions, although of course it can only decide between options which you have decided to include in your program. All decisions are based on testing whether a particular condition — or test — is True or

False. Many decisions can be made using only the simple relational operators:

- = equal to
- > greater than
- < less than
- <> not equal to
- >= greater than or equal to
- = less than or equal to

Both numbers and strings can be compared, but with strings you must make sure that there are no invisible spaces hiding at the end of words. If you test whether

"FIRST" = "FIRST"

then the answer will be no, and similarly "BYTES" is not the same as "bytes". The last two relations are not absolutely necessary, particularly when dealing with numbers, as it is often as easy to write a program which does not need them.

10 IF A >= B

is equivalent to:

10 IF A > (B-1)

Comparisons of conditions may be made more exhaustive — not to say exhausting — by including the logical operators And, Or and Not which combine several tests together in a single program line but can become rather mind-bending.

The first logical operator, And, should be easy enough to understand,

IF test 1 AND test 2 TRUE then whole test TRUE

If both test 1 and test 2 are true then whole test is true but if either test 1 or test 2 is false the whole test is false:

10 IF TEMP = 0 AND DAY = 7 THEN STAY IN BED

and Or is not too bad either,

IF test 1 OR test 2 TRUE then whole test TRUE

that is, if either test 1 or test 2 is true the whole test is true:

10 IF MONEY = 0 OR SHOP = SHUT THEN HARD LUCK

but Not often causes chaos as it looks at first sight as if it works backwards.

IF NOT test 1 FALSE then whole test TRUE

If test 1 fails then the whole test is True: although the sense of the logic can be seen if you consider:

10 IF NOT (DAY = PAYDAY) THEN NO MONEY

Keith and Steven Brain

THE BUGS

each bit of the program is doing. For instance:
REM PLOT VALUE

OI

REM ASK NEXT QUESTION

Many errors show up immediately you read through the program, because what the Rem say and what the code is obviously doing are quite clearly different.

Rems are also very useful for keeping track of what you are using your variables for. It is a good idea to set aside the first 100 line numbers of each program for Rems, mainly to describe variables. Each time you add a new variable, go back and write a Rem saying what it is for:

40 REM H IS HEAD POSITION 50 REM T IS TAIL POSITION

A good way of developing your own bugfree programs is to keep running a program as you type it in. Apart from making the whole process more interesting, most errors are thrown up very soon after you have typed in the lines causing the problem, so it is easier to sort things out.

Another way of developing programs which makes tracking down errors easier is to make use of "stubs". This approach lets you sort out the main point of the program first, and the fiddly bits are sorted out later. A stub is a subroutine which does the fiddly bit in a provisional, simple way.

For instance, if each time an object hits the side of the screen you want to make an elaborate noise, you can put in a Rem

REM GO AND MAKE ELABORATE NOISE at the appropriate point in your program. Under the remark you put a Gosub instruction off to a high line number, and at that line number you put a very simple routine which merely makes a feeble beep and then Returns.

When you run the program you will know that the noise is occurring in the right place, and you can give your full attention to sorting out the rest of the program.

It makes sense to put all your subroutines together, separately from the rest of the program flow, perhaps at the end of the program, with very high line numbers, say over 10,000. With some machines it is better to put them at the beginning, especially if the subroutines are used often, because the Basic interpreter may take longer to find line numbers towards the end of the program.

With subroutines it is especially important to include plenty of Rems, as you may be calling a particular routine from several different points in your program.

If you are adding lines to a program to help you write it which you intend taking out later — either Remarks, or perhaps Print statements — it is important to be able to get them out without introducing new errors. A very common error message is

UNDEFINED STATEMENT IN LINE n
which is caused by branching to a non-existent
line. Sinclair Basic is unusual in that it lets you
get away with this, assuming you mean the
next highest line number.

To help me keep track of lines I might want to get rid of, I give them odd line numbers. Usually I use only even line numbers, and go up in increments of ten. So if I see a line 51 in my listing I am automatically suspicious about it once I have finished testing a program.

With Rems it is also easy to put recognisable characters in the line, for instance a string of asterisks, so you can find the lines you want to pull out easily later. Remarks do not have to be on a line of their own, and can be used after a colon to flag other testing lines. *Ian Stobie*

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51 × 24 DISPLAY

The DRAGON 32 is an incredibly powerful and versatile computer, but for text editing it has some major drawbacks. The small 32 character by 16 line screen format shows you too little of the text and, combined with its lack of lower case letters, bears little resemblance to the way text really looks on the page. Reverse video in place of lower case just adds confusion.

Telewriter eliminates these shortcomings with no hardware modifications required. By using software alone, Telewriter creates a new character set that has real lower case letters, and puts 24 lines of 51 characters on the screen. That's more on-screen characters than Apple II, Atari or TRS-80 Model III. That's more than double the DRAGON 32's standard display.

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. . . truly a state of the art word processor . . . outstanding in every respect - The RAINBOW, Jan. 1982 The only one with all these features for your DRAGON 32

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Special MX-80 driver
Requires absolutely
no hardware modifications
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also available

key, tells you how much space you have left in memory, and warns you when the buffer is full.

FORMAT FEATURES

When it comes time to print out the finished manuscript, Telewriter lets you specify: left, right, top, and bottom margins, line spacing and lines per page. These parameters can be set before printing or they can be dynamically modified during printing with simple format codes in text.

Telewriter will automatically number A4 pages (if you want) and centre lines. It can chain print any number of text files from cassette without user intervention. You can tell it to start a new page anywhere in the text or pause at the bottom of the page.

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Because the Telewriter makes using cassette almost painless, you can still have a powerful word processor without the major additional cost of a disk. The advanced cassette handler will search in the forward direction till it finds the first valid file, so there's no need to keep retyping a load command when you are lost in your tape. The Verify command checks your cassette save to make sure they're good. You can save all or any part of the text buffer to cassette and you can append pre-existing files from those you have in the buffer already.

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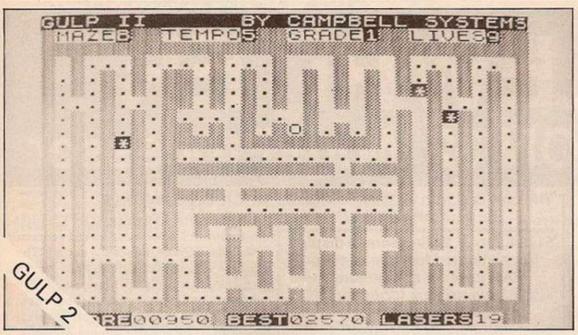
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- Color Computer News, Jan. 1982



IT IS NOT easy to review software for the ZX-81 without using the weary old disclaimer "Given the limitations of the machine . . . ", and I am not going to try. These limitations, as every owner must be well aware, are the primitive graphics and the absence of sound or colour. The limitations, of course, are far outweighed by the advantages; at about £50 the ZX-81 made home computing available to practically anyone who wanted it. After all, £50 is only 50 packets of cigarettes, or for younger readers about 350 Mars Bars.

To produce a version of Scramble, then, for the ZX-81 might seem as hopeless as trying to paint the Forth Bridge with a toothbrush. Yet it works surprisingly well. In Mikro-Gen's version all the usual features are there: the rugged terrain, guns, missiles and smart bombs, the different defence zones. If your gun seems to fire more like a peashooter than a Mig-21 you must remember that, given the limitations of the machine, this game is pretty

Another old favourite produced for the ZX-81 is Invaders. Silversoft's and Bug-Byte's versions are, understandably, very similar. Both have different skill levels and the rather chunky aliens come fast and furious at the highest level. At the lowest level the games have a strange slow-motion effect, as if the invaders were on tranquillisers.

One thing games on the ZX-81 bring home to you is the magical and often hostile properties of letters. In Mikro-Gen's Tempest, a clever variant of Scramble, you have to survive as long as possible against the alien Spinners, Liners, Walkers and Asteroids. These aliens are none other than wandering letters and symbols; it is rather like being under attack from a psychotic typewriter keyboard. The Walkers - Ws - wander all over the screen while the Asteroids - formerly friendly asterisks - come straight at you. More dangerous than either of these are the Untouchables, one of whom bears a remarkable resemblance to the space bar. If you do not use your smart bombs, they will crush you. The game is in five sectors, through which the aliens increase in speed. The pleasing thing about Tempest is that Mikro-Gen have made necessity the mother of invention and used the ZX-81's simplicity to create a game of almost surreal charm.

Galaxians from Quicksilva has something of

the same interest. Here, the first wave of swooping aliens consists of flying Vs. But if you think those are dangerous, you'd better look out for those Ws lurking at the top of the screen. W is a genuinely nasty letter. Given the limitations et cetera, et cetera, Galaxians is a good version of the standard game. It is fast and if you miss the sound effects you could always make them yourself.

Several other arcade favourites are now available for the ZX-81. DJL Software has produced Frogger and Psion has the same game as Frogs. Both are good versions, with the logs really rolling at the highest levels. DJL's version, though, has the slight edge; as the game progresses you encounter the additional hazards of snakes and alligators. There is also the extra task of rescuing cute baby frogs from the logs on your way across. It is heartening to see software houses encouraging a sense of civil responsibility.

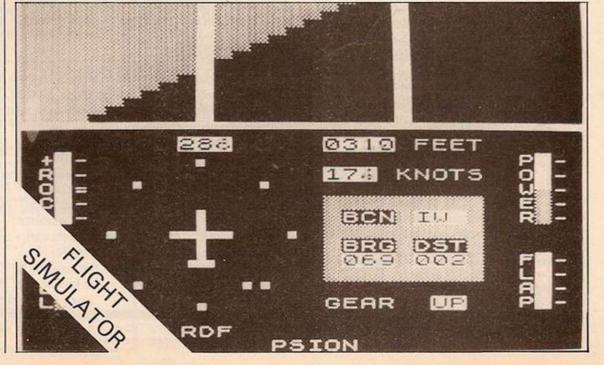
Personal Software Services - PSS - has a Krazy Kong game on the market. You have to climb a pyramid and knock out Kong's support. Obstacles to succeeding are barrels and fireballs which you must jump over on your way to Kong at the top. The graphics are good and make Kong a lively and exciting game.

What seems to be the only version of Centipede for the ZX-81 has been produced by Llamasoft. This is a very distant relation of the

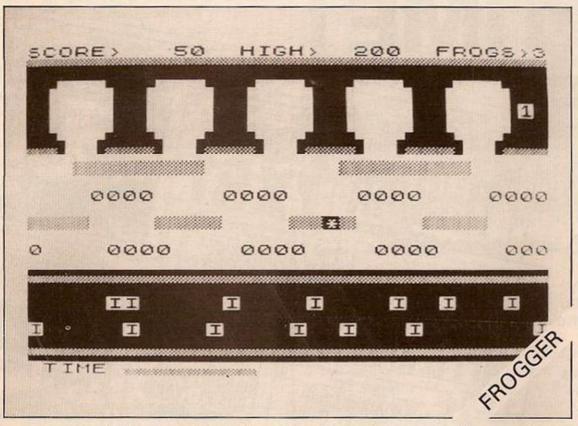
SURVEY All systems are go as Peter Connor explores the weird and wonderful lengths to which software houses go to create programs for the ZX-81.

Arcade game. Rather than threading its way through a forest of toadstools the centipede is unimpeded and descends too quickly.

Two games which are deservedly best-sellers are Gulp 2 from Campbell Systems and Flight Simulation from Psion. Gulp 2 is similar in quality to the version available for the Spectrum, which means it is very good indeed. It is similar to Pac-Man in that your man has to eat the dots in the maze while being pursued by hostile monsters. What is impressive, though, is that there is a choice of fifteen different mazes; you can even have one in the shape of the letters ZX-81. The speed can be set, there is a choice of two keying systems, and the game will give you a demonstration before you begin. It is not hard



ZX-81 SOFTVARE



to see why this game has proved so popular.

Flight Simulation is just what the name says

— a realistic and complicated simulation of
flying. You have to direct your plane to the
airport and then land it. There are two
separate displays. The first is a cockpit with
a view of the horizon and control panel.
The second is a map showing your
position relative to the landing strip,
which enables you to navigate.

It takes quite some time to master the technique of landing since you have to co-ordinate height and speed then bank and dive to your death watching the horizon sway sickeningly through the cockpit windows. The more sophisticated will take the time to master the techniques of flying and

landing, perhaps so that they can take over when the pilots of their Boeing 707 die from food poisoning.

But software does not have to be as complex as this to be enjoyable. Psion also markets a version of Breakout called Thro' the Wall — on the same tape as their Scramble. It is just as you would expect; a bat, a ball and a wall of bricks. The simple pleasures of this game take one back to the days when a computer pingpong machine was as awe-inspiring as the first sunrise. The uncomplicated principles of games such as Breakout might guarantee their existence in an age of ever more noisy and baroque programs.

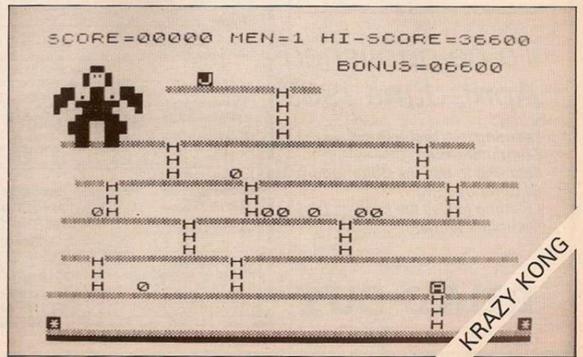
Amba Software has two similarly straightforward games; Trap and Hunt. In the first you play an opponent, or the computer, and have to block off areas of the screen by drawing lines. In Hunt, again a two-player game, you chase numbers in a maze; as time runs out the value becomes smaller. There is something compulsive about Hunt, involving as it does, the race against time and avoiding obstacles.

Adventure games are one field where the ZX-81 does not lose much by comparison with more powerful machines. This does not mean that games for the ZX-81 are different or better; on the whole we get a tepid goulash of the same leftovers. Fantasy games from Psion offer two adventures, Perilous Swamp and Sorcerer's Island. The deep stagnant pools of the first sum up the whole world of the adventure game. The princess, the evil wizard, the slimy green bunyip, the horrible dirty troll; love them or hate them, you cannot play an adventure game without them.

At least, it seemed you could not. Dictator, from Bug-Byte, looked like a welcome exception. Here, you are President for life of the banana republic of Ritimba. In this somewhat amoral game you have to exploit the country for your own good and then make your escape before the guerillas, or other opponents, get you. However, the colourful blurb and drawings flatter only to deceive. When you settle down to be a ruthless and evil megalomaniac you will be disappointed by the dullness of the game itself. Quicksilva, though, has succeeded in finding something different. Trader - in three parts - is more of a semi-adventure game; there are the usual decisions to be made, but also tasks such as piloting your ship or finding your way through a maze.

The variety of activities and the clever graphics make this much more entertaining than the usual adventure. Your objective, of course, is to make a huge profit by trading with the inhabitants of the Meridien system, all of whom have different needs and characteristics. The Psions are immensely intelligent beings, constantly rearranging the blobs which constitute their bodies. They are con
(continued on page 45)

niques of flying and



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Learning to Use the Dragon 32

Learning to Use the Dragon 32

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Learning to Use the Oric 1

Learning to Use the Commodore 64

(continued from page 43)

temptuous of human intelligence and, before doing business with them, you will have to answer their questions correctly. With Betans you must bargain. With the robotic Alphans you can only take it or leave it. On Delta though, you can make a killing.

These junkies will pay an enormous price for your Boosterspice, a kind of inter-galactic heroin. But you have to be careful they do not mug you or your might pass out of the Meridien system, as I did, in a sordid back alley. Trader is great fun — do not be put off by the unnecessary packaging and silly booklet.

Traditional board games are also in evidence in ZX-81 software. Psion has both chess and backgammon tapes. Of the two programs backgammon is the more satisfying, since it suffers less from the graphics limitations of the ZX-81. By playing the computer you can teach yourself how to play the game. The display is clear and wrong moves are explained. Chess, on the other hand, is rather confusing; as the program notes suggest, it is a good idea to set up the game on a normal board. Another drawback is that moves are entered using algebraic notation - for example, E2-E4, but the board on the screen has no letters or numbers. If you are not familiar with the system it can take you some time to figure out what to enter. The computer's response is quick at levels 1 and 2, but on level 3 can take several minutes. At the two lower levels it plays a reasonable, though not very strong, game of computer chess.

Better value

Campbell Systems,

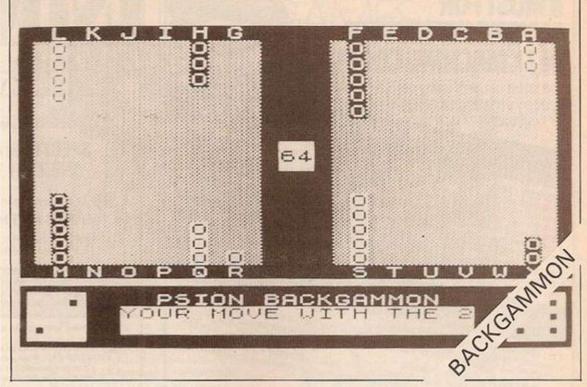
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The Fast One

Generally, those programs that have some practical application are better value than the games software and, to my mind, more interesting. Games, after all, are not the ZX-81's forte; most people buy the machine primarily as an introduction to computing rather than as a games machine.

In particular, probably more people have gained some familiarity with machine code on the ZX-81 than on any other home micro. Few Vic owners for example know where or how to insert machine-code routines; every dedicated



ZX-81 owner, by contrast, has learned the value of a hex loader or the significance of the figure 16514.

An assembler, of course, removes the hassle of hex loading. Bug-Byte's ZXAS allows you to enter standard Z-80 mnemonics in Rem statements and also accepts labels for jump and call instructions. It takes up 5K and will assemble code at any specified location.

Assemblers are indispensable to the serious machine-code programmer and Bug-Byte's is as effective as any other available. To go with it the well-equipped programmer also needs a machine-code monitor. Two on offer are from Picturesque and Crystal Computing. These are both well-written and useful programs although the Crystal Computing monitor is perhaps the superior version. In addition to providing a range of facilities for entering, displaying, moving and testing machine code, it also supplies a disassembler and the option for saving and loading blocks of memory in any part of RAM.

insert machine-code routines; every dedicated Picturesque's Screen Kit 1 contains a varied Price Company Software Price Company Software Psion, £6.95 Crystal Computing, Monitor £8.95 Chess Sinclair Research, Flight Simulation 2 Ashton Way, Stanhope Road, Backgammon £5.95 East Herrington Camberley, £4.95 Sunderland SR3 3RX. Thro' The Wall Surrey. Fantasy Games **F5 95** £5.70 Screen Kit 1 Vu-File £7.95 Picturesque, 6 Corkscrew Hill, ZX-MC £7.50 Mikro-Gen, Tempest £3.95 West Wickham, Kent BR4 9BB. 24 Agar Crescent, Scramble £3.95 Bracknell. Frogs DJL Software, £5.95 Berkshire. Frogger 9 Tweed Close, £4.95 Swindon. Amba Software. Hunt £4.95 Wiltshire. Freepost, Trap Cambridge CB3 7BR. MCode £6.00 452 Stoney Stanton Road, £7.95 Bug-Byte, ZXTK Krazy Kong 100 The Albany, ZXAS £5.00 Coventry CV6 5DG. Old Hall Street, Dictator £9.00 Silversoft, £3.95 Liverpool L3 3AB. Invaders £4.00 Invaders 20 Orange Street, London WC2. £4.95 Quicksilva, Galaxians 92 Northam Road £9.95 Trader Southampton SO2 0PB. Llamasoft, Centipede £2.45 49 Mount Pleasant,

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selection of machine-code routines which are embedded in Rem statements and can be used from Basic programs. These include routines for scrolling in any direction, saving and loading variables, and displaying the amount of memory left. Most of these routines have already been published in home computer magazines — or, at least, in Your Computer — but the collection could be recommended to newcomers.

Rather more useful is Bug-Byte's ZXTK toolkit. Again this is a suite of Rem-based routines but specifically intended as aids to program development. There are ten options which offer such features as renumbering and deleting of Basic program lines as well as facilities for moving and merging programs whenever you want.

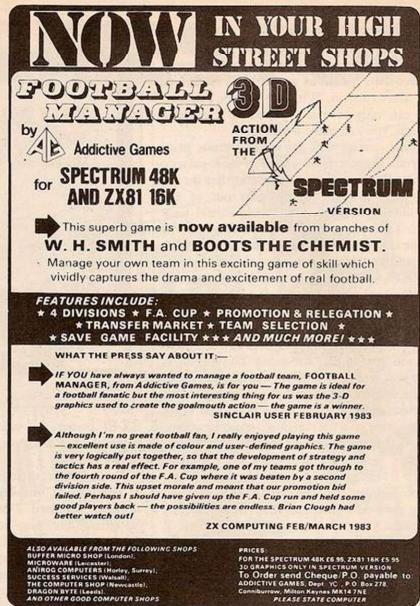
Question of ease

There is not much to choose between the two programs. The Fast One leaves around 11,700 bytes free for file space and offers a greater range of features — including an option for finding the total and average of figures within selected records. Vu-File on the other hand has slightly less file space but is easier to use.

None of these facilities would be exceptional if they were present on a larger micro; but on the ZX-81 the speed and versatility of these programs is quite an achievement — given the limitations . . .

The final word in this review, sadly, must be a critical one. Many of the programs discussed were loaded only after repeated attempts. Some programs could not be reviewed because they obstinately and persistently refused to be loaded, even when tried on different recorders. One of these brutes was, unfortunately, Gauntlett - a game I would have liked to play as it features in Your Computer's Top Twenty. An honourable mention has to be made here of Psion, whose programs all loaded first time. While conceding that the ZX-81 is a sensitive beast which must be approached with caution, I do not see why manufacturers cannot take a little more care with their products and help the consumer to avoid the frustration and rage which are the result of faulty loading.







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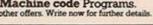


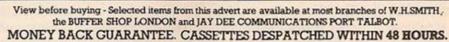


BATTLE: Destroy

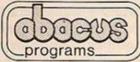
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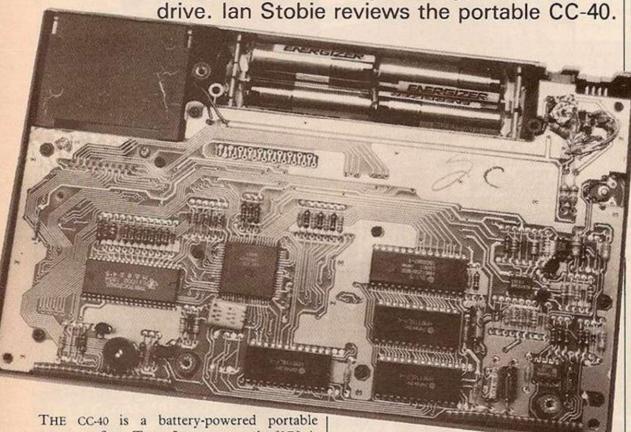
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Abacus Proara

TEXAS

Compact Computer is the first of a new wave of micros from Texas which have been designed to use a range of miniaturised peripherals including a stringy-floppy tape



THE CC-40 is a battery-powered portable computer from Texas Instruments. At £170, it is in the same price range as the Dragon and the 48K Spectrums and Orics — but that is its only similarity. The Compact Computer will never know the satisfaction of crushing a human at space invaders; it is a machine with a serious purpose.

Up until now Texas has taken care of the home market to its own satisfaction with the TI-99/4A. The Compact Computer 40 is an attempt to get into the booming portable market, currently dominated by names like Epson, NewBrain, Casio and Sharp.

The CC-40 weighs a little more than onepound and measures 9.25in. wide by 5.75in. high by lin. thick — about the size of a big paperback. It can run for 200 hours on four AA size alkaline batteries and it has a built-in 31-character single-line liquid crystal display and good-quality calculator-style keys in a QWERTY layout.

Cartridge slot

Inside, the CC-40 is built around a Texas own-brand eight-bit CMOS chip, the 70C20. It comes with 34K of ROM containing a comprehensive Basic, and 6K of RAM extendable to 18K internally. A cover at the top edge of the machine to the right of the display pulls off to reveal a memory cartridge slot, and a further 16K of RAM can be fitted here, giving an absolute maximum of 34K RAM. Program cartridges also fit into this slot.

Texas expects great things for the new

peripherals designed for the CC-40. These include a battery-powered four-colour printer/plotter of the Sharp type, a fast "Wafertape" continuous loop cassette drive like Sinclair's Microdrive, and an RS-232 interface unit for connecting up to big printers and, potentially, other computers.

A Modem and a black and white TV interface are also scheduled for release later in the year. The CC-40 system is clearly aimed at people using computers for their work; but this could include students of scientific or engineering subjects as well as professional users.

The whole machine is well made. For instance, along the bottom of the machine runs a recessed stand, which can be pulled down to tilt the keyboard to a nice angle for typing. There will be no need for entrepreneurs to offer adaptor feet at £4 a pair.

The casing itself is made from a silvery-grey plastic, except for the numeric keypad, a few of the other keys and the area around the screen, which are highlighted in a darker grey.

At the back of the machine is a slot for the optional AC adaptor which costs £14.95, and the Hex-bus connector, into which all the peripherals will fit.

There were no problems with the keyboard. The calculator-like keys feel comfortable and give tactile feedback. The layout is fairly close to the standard QWERTY pattern, but the Enter key, the Texas equivalent of Return, is

rather annoyingly positioned where you might expect the right-hand shift key to be.

Given the size of the CC-40 the keys are obviously smaller than on a standard typewriter, but they are easy to use and larger than on the Sharp PC-1500 for instance, a machine with virtually the same price and an obvious competitor.

The CC-40 comes with a plastic keyboard overlay, which among other things has the principal Basic keywords on it. Basic keywords can either be typed in full in the normal way, or by using the function key then hitting the appropriate single key given on the overlay, the machine can be made to produce them Sinclair-style on the display. This is a useful time-saving feature, although the overlay itself might soon be lost.

Program scrolling

The display is a single line of 31 characters, but this can be used as a window on to an 80-character line. The arrow keys above the keypad can be used to scroll around horizontally within the line, or to step vertically within through a program listing. With a little practice the small display does not seem such a limitation, although for developing long programs the printer at £149.95, would be essential.

On the side of the machine to the left of the display is a knurled wheel. Turning this adjusts the display angle electronically, so you can aim it at yourself to get the best contrast.

The characters are formed on a five-by-eight matrix, and like all LCD displays are much less tiring to watch than a TV screen. The lack of colour confirms that this is a working machine, rather than an entertainment device.

On both sides of the actual text line in the display one finds indicators showing battery-low warnings, upper-case lock on, Function, and which units the trigonometric functions are currently returning value in.

The machine can be used as a calculator. It works exactly the same as Basic in immediate mode, but on the CC-40 it is not necessary to type Print before a calculation. You just key in 8*63 and then hit Enter, and it gives you the answer.

The up-arrow key, used with Control held down, functions as a playback key. Hitting it brings back the last line entered on to the display, where it can be edited, and the calculations redone. This saves time if you have entered a long complex calculation and want to try it out with a few different values.

For anything more complex there is Basic, and the CC-40 has a very full Basic. Again, it is practically oriented. There are no sound commands to support the small internal beeper, only the feeble Beep, but this is sufficient for attracting attention.

The numeric precision is good — 10 displayed significant digits — but the machine is not very fast. Battery-powered CMOS machines are inherently slow.

If your foreign languages need brushing up try, Call Setlang 1

This puts out all the error messages in German — Variable nicht definiert — and that kind of thing. Other languages are available on ROM cartridges.

The Basic has all the usual commands of



Microsoft-style Basic. It includes If . . . Then . . . Else, On . . . Goto/Gosub/Error, Print Using to format output conveniently, and various file control commands for use with the Wafertape, like Open, Print#, Input#, and Verify. Three-dimensional arrays are allowed, and long variable names.

Strings can be up to 255 characters long. String handling works differently to most home micros. Instead of Left\$, Mid\$, Right\$ the CC-40 has a Seg\$ command for extracting substrings, and a Pos command to find them.

Another addition is the way subroutines are handled. Gosub is there and can be used in the

normal way, but there are several more powerful commands allowing you to set up sub-programs. These are called with a Call statement and an optional set of parameters.

The 34K ROM contains a number of useful sub-programs. Call Debug gets you into a machine-code monitor, with all the usual Examine, Move, Copy and start Executing commands, plus the ability to set Breakpoints.

The CC-40 manual which describes all this is extremely good. It is a 300-page professional manual, not just a home micro manual.

Ready-written software will be available on cartridges and Wafertapes. Statistics, Finance, Maths and Electronics cartridges should be available immediately, with Perspective drawing, business graphics and a few others hot on their heels according to Texas. These all cost £59.95. Two games cartridges cost nearly £40, and the Assembler nearly £125, so

software is not cheap.

The Wafertapes will be cheaper, just under £20. Again the announced titles look fairly professional — things like Elementary Dynamics, Pipe Design, Profitability Analysis. Texas hope to find third-party software suppliers to contribute additional titles.

BENEATH THE STREETS of Cambridge he waits for the call. A spear hangs from the ceiling, a sword from the wall. Any moment the red phone could ring and send Captain Spectre's Flying Squad and their electronic ghost trap out on the trail of another ghoul.

The scene sounds straight out of *The Avengers* but Captain Spectre's quarry is more elusive than any that Emma Peel or John Steed tracked down. His mission is to capture for the first time on film denizens of another world — spirits, poltergeists, ghosts. His only weapon is a 16K Spectrum linked to an array of sensors, lights, recorders and cameras.

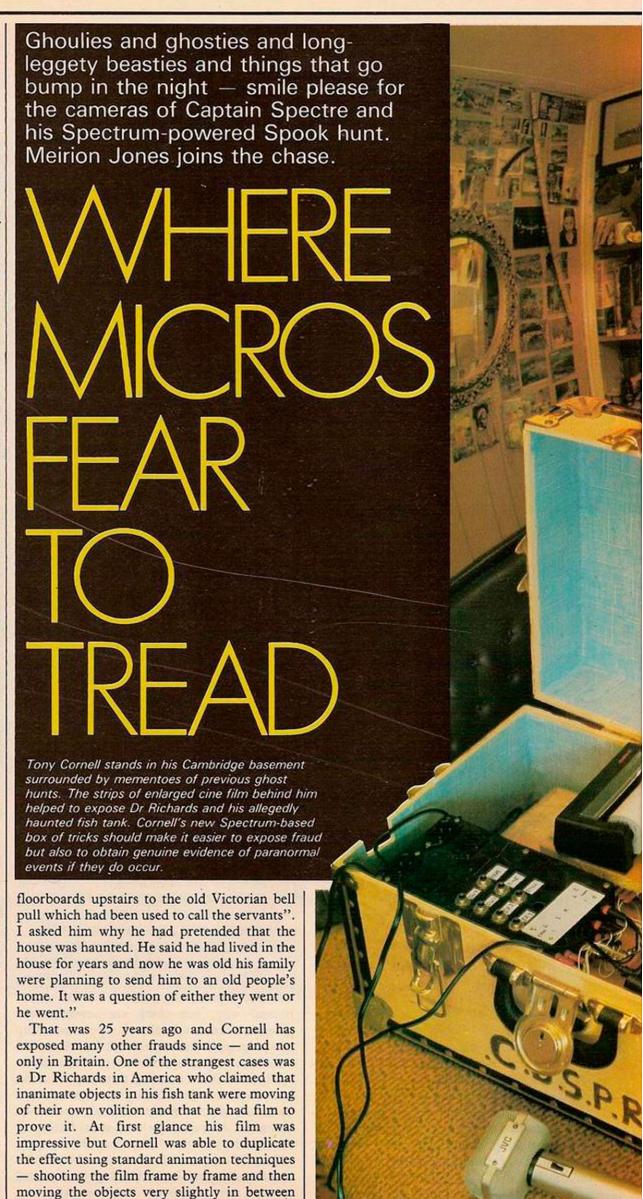
Captain Spectre — or Tony Cornell as he would rather be known — is fully aware of the problems of capturing spirits on celluloid. As Treasurer of the Society for Psychical Research he has been able to leaf through the thousands of supposed ghost photographs sent to the SPR since it was set up a century ago to investigate paranormal phenomena. He believes that there is "not one photograph in the archives that we would today accept as genuine."

Traditional methods of investigating haunted houses or poltergeists, are unlikely to produce scientifically acceptable results. An observer who has been left for the night in some gothic manor is quite likely to be seeing things by the early hours of the morning whether they are there or not and if anything should happen the observers may not be able to turn on recorders or take a photograph in time.

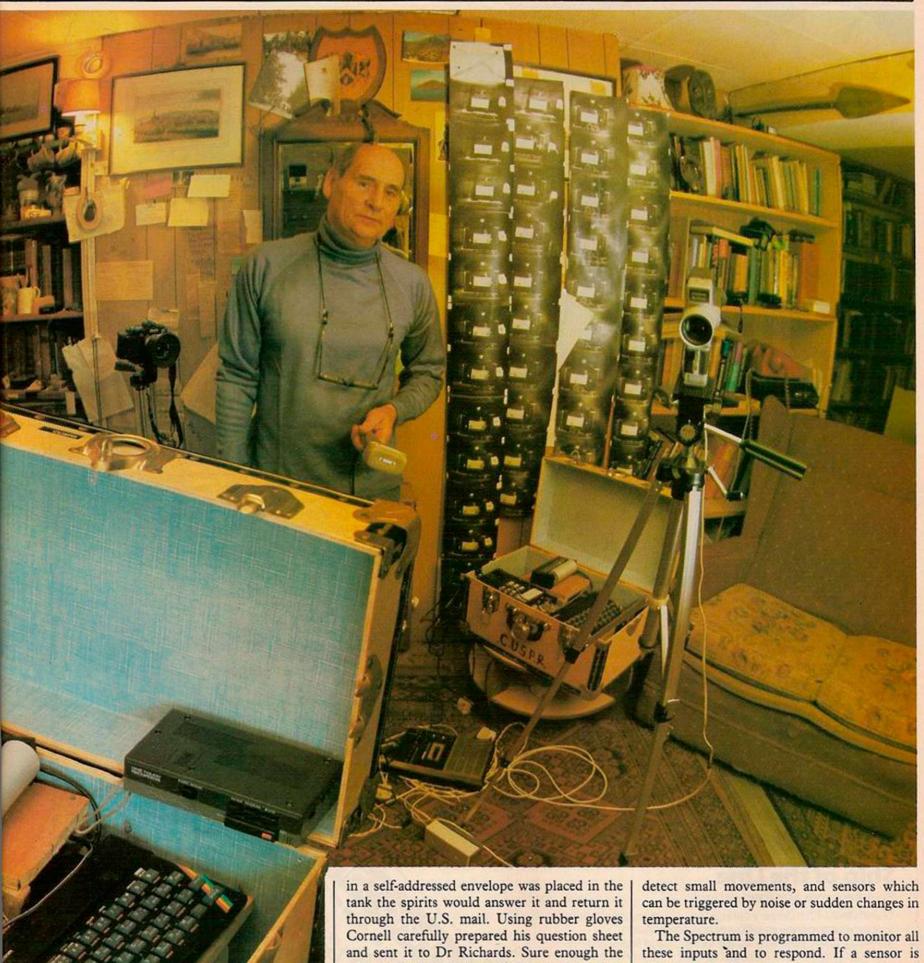
An automatic observation station with cameras and recorders that can be instantly triggered by movement, temperature changes or sound and can be left to monitor a site for days at a time is far more likely to produce useful results. It is also less likely to be taken in by the many deliberate frauds and practical jokes which have often taken in investigators of the paranormal. Sherlock Holmes's creator Sir Arthur Conan Doyle who joined the SPR after pushing his all-seeing detective off the Reichenbach Falls remained convinced to the end of his life by a film purporting to show fairies dancing at the bottom of his garden. Last month - 60 years later - one of the fairies, Mrs Elsie Hill, finally admitted that it had all been a hoax.

Alan Cornell's first investigation of a poltergeist convinced him of the dangers of taking things at their face values. He had gone to an erie-looking Victorian house in North London where a mysterious crashing and banging noise in empty rooms had convinced a family that the house was haunted. The father, mother and three children had all moved out leaving only Grandad who refused to be scared off. On the evening that Cornell called in the old man was sitting in a corner by the fireplace. Cornell sat down and shortly afterwards he heard "thumps and bumps and crashes and bangs upstairs". A check of the upstairs room yielded no clues - there was nobody else in the house apart from the old man downstairs in his armchair. When the noise started again Cornell noticed out of the corner of his eye that Grandad was moving his shoulder.

"He had connected up two wooden balls and a heavy piece of lead under the



Dr Richards then claimed that if a question



answer came back through the post but when fingerprint powder was dusted over the sheet it revealed that Dr Richards' spirits had human finger and palm prints.

Although Cornell soon realised that automatic continuous surveillance equipment would make psychic research much easier, until recently the cost of such a system would have been prohibitive. Cheap home computers changed all that. The box of tricks at the heart of Cornell's monitoring system contains a 16K Spectrum, a Sinclair printer, a DCP Interspec, and a series of relays. An array of sensors can be connected up to the box. These include two infra-red beams and a doppler-shift ultrasonic alarm to detect movement, circuit breakers to triggered the Spectrum turns on lights and runs a cine camera for 20 seconds. It also turns on a tape recorder for one minute and takes six still photographs with a motor-driven camera. The program also helps set up the equipment by checking through stage by stage with the operator that everything has been correctly connected. The Spectrum prints out a record of what responses were triggered and when. Once it has been set up the equipment can function for several days without attention.

The first test for the new box of tricks came this Christmas. A 200 year-old chest of drawers in an antiques warehouse had been at the centre of some strange happenings. For (continued on page 53)



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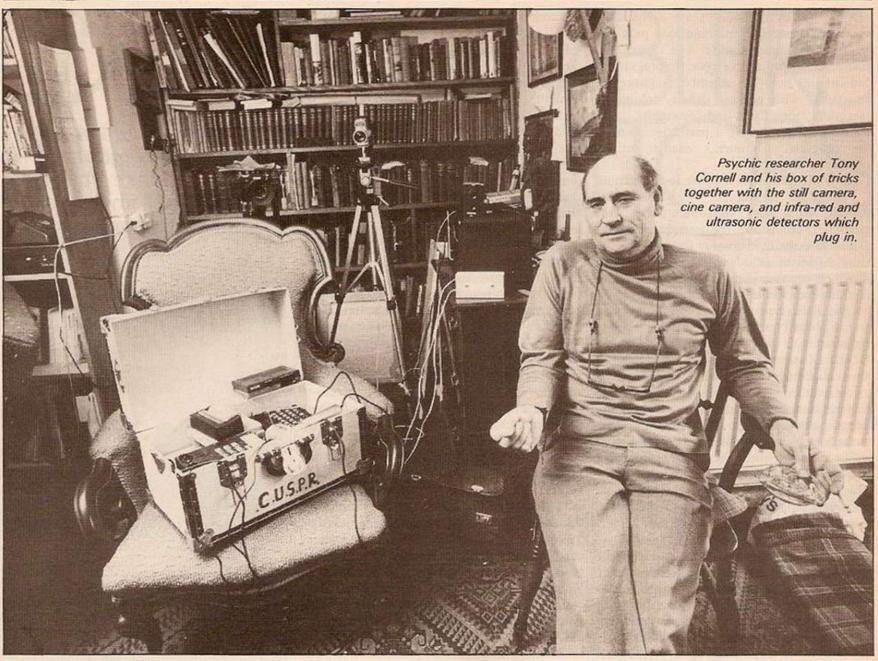
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(continued from page 51)

weeks every morning when the staff came in the drawers would be hanging out at strange angles even though they had been pushed in when the staff had locked up the night before. Eventually Tony Cornell was called in. He and the Cambridge University Society for Psychical Research, CUSPR, staked out the storeroom the chest was in with their box of tricks. The response was triggered eight times but the drawers had not moved and there was nothing unusual on the film. The equipment may have been triggered by a spike in the mains current so a mains smoother has subsequently been fitted. Since then there have been no further strange happenings with the chest which now sits uncomfortably in Tony Cornell's basement with two tribal sculptures eyeing it suspiciously from across the room.

Cornell is cynical about haunted houses — he believes that ghosts may be in the eyes of the beholders once they have been told that a particular place has a spooky reputation. Once he and several members of the SPR were invited to the Ferryboat Inn in Huntingdon to witness an apparition by the White Lady who was supposed to appear every March 17. "The landlord gave us dinner, there were hundreds of sightseers, Americans everything. No-one had ever seen the White Lady — it was terrible. Some months later I saw it in a Sunday magazine described as 'The fifth most haunted house in Britain'."

Because of his own experience he is less

cynical about poltergeists. At Hanneth Hall in Wisbech, Cambridgeshire, he was among a team of investigators who tore the place apart looking for any normal explanation of the bumps and thumps and objects flying around which they experienced there.

At one time it was thought that such effects might be caused by vibration perhaps from underground streams or seismic activity. Cornell's own experiments convinced him that was not the case. He obtained permission to subject four cottages which were scheduled for demolition to intense vibration. Although the tests were continued to the point when the cottages were about to collapse they were unable to duplicate the effects attributed to poltergeists.

Spectrum telepathy

Richard Loosemoore, who built Cornell's box of tricks for just over £200 — the cameras and sensors are borrowed as and when necessary — is hoping to use a 48K Spectrum for more psychic research. He is conducting research into Artificial Intelligence — in particular cognitive psychology. But his own interest is telepathy. He believes that "there is no question about the proof of telepathy — it is just a question of what the mechanism is."

In Loosemoore's experiments two volunteers sit in separate rooms and one attempts to transmit his or her emotional state — agitation, relaxation or anxiety — to the other by telepathy. Using the same principle

as a lie detector the observers measure the Galvanic Skin Response — changes in skin conductivity — of both volunteers. If they really are able to transmit emotions by telepathy then the observers should be able to detect simultaneous changes in the GSRs of both volunteers.

In the past Loosemoore has had to borrow expensive purpose-built machines when he can to process and evaluate the data. The CUSPR has now given him £300 which he hopes will allow him to build a new system around a 48K Spectrum which will make it possible to carry out far more tests.

Tony Cornell has found the recent publicity for his investigations of the paranormal to be a mixed blessing. He never knows who is going to be on the other end of the line when the red phone goes. "I could be called out by two raving nutters — there is a lot of cranky stuff in this field". The shelves of Cornell's basement contain everything from Nostradamus's prophesies of doom and destruction to Eric von Daniken's tales of prehistoric spacemen.

Cornell suspects that "some as yet little known human faculty" may be responsible for psychic phenomena. His failure to catch a spirit red-handed opening the 200-year-old chest of drawers has not led him to believe that the spirits have something against being photographed. "After all" he says sounding more like a social worker than a psychic researcher "they are only doing it to draw attention to themselves."

ASSEMBLERS AND monitors are designed to make the process of machine-code programming as simple as possible. The input to an assembler — the source code or program — consists of lines of assembly-language instructions, with optional labels, comments, assembler directives and assembler commands. Labels identify a particular point in the program. Comments enable you to document your program.

Assembler directives are pseudo-instructions
— not Z-80 mnemonics — which either
provide parameters for operation of the
assembler, or instruct the assembler to store
values directly in memory. Commonly provided directives include Org — short for origin
— which supplies the starting address of the
machine code to the assembler and Equ which
assigns a value to a label. DefB, DefW and
DefM insert a byte, word or string
respectively at the current address.

Unlike assembler directives, commands have no effect on the object code produced by the assembler but instruct the assembler to perform certain operations, such as to produce a heading in the listing, or change the address in the listing from hexadecimal to decimal.

The output from the assembler is the hexadecimal machine code — object code — which is loaded directly into memory, and optionally a listing which has the addresses and op-codes added to the source file.

The assemblers reviewed used one of two methods to enter the source code. Either the source code is entered in Rem statements in Basic, or an integral editor is supplied as part of the assembler package. Normally these editors use line numbers, just as in Basic, but with an auto-line number, renumber and block-delete facility. Since most of the time spent sitting at the keyboard is actually spent using the editor, either just entering source code, or else modifying it in the debugging phase, it is most important to have an editor which is quick and easy to work.

Finally having entered and assembled a source file, it must be run and debugged. A monitor is required for this. Some assemblers

List of suppliers	Price
ACS Software, 7, Lidgett Crescent, Leeds LS8 1HN.	
Ultraviolet assembler	£7.50
Infrared disassembler Artic Computing, 396, James Reckitt	£6.75
Avenue, Hull, North Humberside.	
48K Spectrum Assembler Spec Bug monitor	£9.95 £6.95
Bug-Byte, 100 The Albany, Old Hall	
Street, Liverpool L3 3AB. Aspect assembler	£9
CP Software, 17 Orchard Lane, Prestwood, Buckinghamshire HP16	
ONN	f4.95
Spectrum assembler	14.95
Crystal Computing, 2 Ashton Way, East Herrington, Sunderland SR3 3RX	
Zeus assembler	£8.95
Monitor and disassembler Hisoft, 60 Hallam Moor, Liden,	£8.95
Swindon SN3 6LS.	
DevPac	£12
Picturesque, 6 Corkscrew Hill, West Wickham, Kent BR4 9BB.	
Spectrum editor-assembler Spectrum monitor	£8.50 £7.50
Spectrum monitor	L7.50

do contain a simple set of monitor commands but, in general, a more comprehensive monitor is required. In particular, commands are required which allow registers and memory to be inspected and modified, and to run the program from a given address with break-points set to terminate the run at a given address or addresses. Other necessary facilities are the ability to relocate the assembled object code — it may actually need to be run in the area occupied by the assembler for instance — and a disassembler would be required if the assembler does not produce a listing of the assembled program.

In ACS Software's Ultraviolet Assembler, the Basic editor is used to enter source code into Rem statements. A dummy Rem statement, long enough to hold the assembled code, must be created as the first line of the program. The source code is then assembled, by the Ultraviolet assembler and a listing is sent to the screen, with different classes of opcode being printed using different paper colours. The listing can optionally be sent to the ZX Printer. All numbers must be entered in decimal, and multiple statements can be entered in one Rem line. The Infrared disassembler is also available from ACS and produces a similar colourful output to the Ultraviolet assembler.

The Ultraviolet Assembler — from Artic Computing contains a built-in monitor and only runs on the 48K Spectrum. The source code is automatically stored in a Rem statement at line 2, and the object code is put into a Rem statement in line 1. The editor is fairly comprehensive. It does not use line numbers, like all the other products reviewed here, but has a screen editor mode in which the cursor can be moved up and down to point at lines. Lines can be inserted or deleted at the cursor position. A line-editor mode is also available allowing text to be modified.

The assembly is initiated from the built-in monitor, which also allows the assembled program to be run. Most of the normal monitor functions are included, allowing memory and registers to be inspected and modified and blocks of memory to be moved, but it does not have a breakpoint facility which is essential for debugging. Also it has no disassembler, which is vital since the assembler does not produce a listing of the assembled code.

One very useful feature of this product is a memory status report at the bottom of the screen showing how much memory is occupied by the source, object, labels and Basic program and how much is still free. The documentation is good, providing clear instructions and hints and examples to the

The Aspect 4.2 Editor-Assembler by Bug-Byte proved to be a very disappointing program. The editor is most unfriendly. It has an invisible cursor, which makes entering and modifying the source code very difficult indeed. Text cannot be inserted or deleted without first deleting all characters from the end of the line back to the required point. The labels can be of any length but they are cut to five characters length in the listing. The symbol table space is fixed at approximately 450 bytes, which may be very limiting in some

SPECT

To turn those dreams of machine-code programs into living facts, take Phil Holliday's advice on assemblers and monit



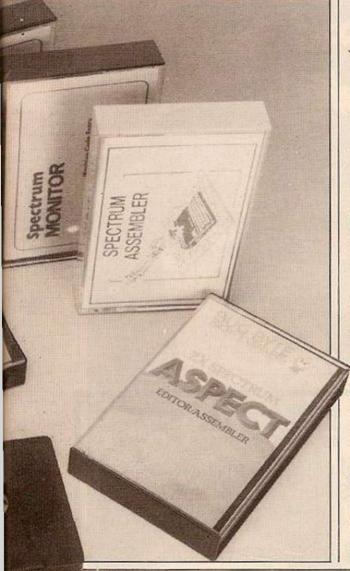
table to the printer, which makes debugging very difficult. The documentation is barely adequate.

The assembler from CP Software is very limited. It is written in Basic and assembles the code at a painfully slow rate. The source code is entered into Rem statements. Labels are limited to three characters in length, and the only assembler directive provided is DefB.

The Zeus assembler from Crystal Computing is a well thought-out program. It has a true screen editor. Text may be displayed and modified by moving the cursor to the appropriate place in a line on the screen. It also has a good auto-line number, renumber and block-delete facility. This editor was easy and pleasant to use. The assembler does not produce a listing, but the source code and symbol table can be sent to the printer or screen. A built-in monitor allows the assembled object code to be run, and has other useful features.

However, a separate and more comprehen-

RUM ASSEMBLERS AND MONTORS



sive monitor is available from Crystal Computing which allows breakpoints to be set and the program to be run and disassembled. The documentation supplied is very good. The manual starts with an example of a machine-code program and the user is taken step by step through the process of editing and assembling it.

The most comprehensive product reviewed was DevPac by Hisoft. The assembler-editor — Gens — and monitor — Mons — are two separate programs but are sold as one product — DevPac. The editor is an extremely comprehensive line editor. It takes a little time to learn to drive it but it is well worth the effort. It includes auto-line number, renumber and block delete.

The line-editing commands available are too numerous to list here. Some examples are commands to delete or insert characters, delete all characters from the cursor to the end of the line, reload the edit buffer from the text and many others.

The assembler is very fast and the only one reviewed with the powerful conditional assembly feature If-Then-Else. It also allows expressions of decimal, hex, binary, character constants and labels with operators of addition, subtraction, integer multiplication and division, logical And, Or and Xor, and mod operators. There are many assembler commands available which can be inserted into the source code. It is possible to enable and disable the listing and printer, and to list the location counter in hexadecimal or decimal

with the appropriate commands. Options can also be selected at assembly time, enabling the object code and listing to be turned off, and to direct the listing to the printer.

The Mons monitor provides all the usual commands one would expect. Registers and memory can be inspected and modified, and memory can be moved. It also contains a disassembler which inserts labels into the disassembled listing. The object code can be executed, and break-points set, but what sets this monitor apart from all the rest is that it can be single-stepped through the program, with a disassembly of the instruction executed displayed. Commands are available which allow single-stepping to continue after a jump or call. This, like the assembler, is a most comprehensive tool. The DevPac will appeal to the true machine-code freak who wants to write a lot of software. The documentation is first class.

The first thing that you notice about this neat product, the Editor Assembler by Picturesque, is that instead of the normal 32 columns on the screen it gives you 40. This is a very real advantage for listing the assembled source program. The whole package is very friendly and easy to use. The line editor is quick and simple to use.

The line is automatically set up with tabs at the required places. This is the fastest editor to use of all those reviewed. The only criticism is that characters cannot be inserted within a line without first deleting characters from the end of the line back to the required point.

The assembler is fast and the listing produced is very easy to read because of the 40-column line. The listing can be turned off or sent to the printer at assembly time. An extremely useful function, especially for those with 16K machines, is that once a module of source code has been assembled it can be cleared from the text buffer whilst retaining the symbol table. Thus a large program can be split into smaller modules and still be assembled, even with label references which cross module boundaries. To help this there is an assembler directive, DefL, available which allows a label value to be redefined within a program. Source and object code can be saved to tape from within the assembler.

A monitor program, which has all the normal monitor commands and includes a disassembler, is also available and documentation for both products is very good.

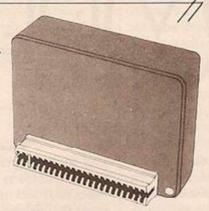
The Picturesque and Crystal Computing products can be highly recommended for those who are just about to start programming in machine code, whilst for those who are already familiar with the techniques then the DevPac is most highly recommended.

Table 1.					
mpany	ACS	Artic	Bug-Byte	CP	Cryst

Company	ACS	Artic	Bug-Byte	CP	Crystal	Hisoft	Pictures
Product name	Ultra- violet	Assem- bler	Aspect	Assem- bler	Zeus	Gens	Assem- bler
16K	Yes	No	Yes	Yes	No	Yes	Yes
48K	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Label size	Any	Any	Any	3	14	6	5
Hex	No	Yes	Yes	Yes	Yes	Yes	Yes
Decimal	Yes	Yes	Yes	No	Yes	Yes	Yes
ORG	Yes	Yes	Yes	No	Yes	Yes	Yes
EQU	Yes	Yes	Yes	No	Yes	Yes	Yes
DEFB	Yes	Yes	Yes	Yes	Yes	Yes	Yes
DEFW	Yes	Yes	Yes	No	Yes	Yes	Yes
DEFM	Yes	Yes	Use DB	No	Yes	Yes	Yes
DEFS	No	No	Yes	No	No	Yes	Yes
ENT	No	No	No	No	Yes	Yes	No
Cond assembly	No	No	No	No	No ·	Yes	No
Opt assembly	No	No	No	No	No	Yes	No
Save to tape	Basic	Basic	Basic	Basic	Basic	Yes	Yes
Error reports	5	6	4	5	10	17	8
Output to printer	Yes	Yes	No	Yes	Yes	Yes	Yes
Listing	Yes	No	Yes		No	Yes	Yes
Editor	Basic	Screen	Line	Basic	Screen	Line	Line
Documentation	Sparse	Good	Poor	Poor	Good	Excellent	Excellent
Monitor included	No	Yes	No	No	Yes	No	No
Monitor separate	No	No	No	No	Yes	Yes	Yes

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- Thurst	16K RAM for VIC 20	£47.95	
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NAME				
ADDRESS				



```
REM*****BATTLE TANKS******
30 REM*******BY*******
50 REM***************
60 PCLS:CLSO:DIMA(7,4)
70 DATA32,165,173,154,160,33,173,168,171,153,1,160,172,174,147,-31,150,174,162,1
     -32,149,160,170,171,-33,173,153,171,161,-1,167,156,160,163,31,164,174,150,167
FORT-OTD7:FORT1=OTD4:READA(T,T1):NEXT:NEXT
90 GOSUB610
110 L=&H4E1:R=&H4F7:M=32:M2=32:Y=1
120 R1=165:R2=173:R3=154:R4=160:L1=R1:L2=R2:L3=R3:L4=R4
130 PRINT@33,HL;:PRINT@60,HR;
140 IFHL=10 ORHR=10 THEN10B0
150 LR=JOYSTK(0):LM=JOYSTK(1):RR=JOYSTK(2):RM=JOYSTK(3)
 160 PLAY"V3T25503CFC
        IFLM<5 THENX1=L:C=128:XL=1:G0SUB600
180 IFRM<5 THEN X1=R:C=128:XR=1:GOSUB600
       IFPEEK(L-M)>239 ORPEEK(L-1-M)>239 ORPEEK(L-31-(2*M))>239 ORPEEK(L-32-(2*M))>
239
       THEN210
200 IFXL=1 THENL=(L-M)-((L<&H400)*512)+((L>&H615)*512):GOTO220
210 IFG=3 THENX=L:HL=HL-1:GOSUB1030:C=128:X1=R:GOSUB400:GOSUB1140:GOTO950
220 GOSUB350
230 IFPEEK (R-M2) > 239 ORPEEK (R-1-M2) > 239 ORPEEK (R-31-(2*M2)) > 239 ORPEEK (R-32-(2*M
2) 1>239 THEN250
240 IFXR=1 THENR=(R-M2)-((R<&H400)*512)+((R>&H615)*512):GDTD260
250 IFG=3 THENX=R:HR=HR-1:GOSUB1030:C=128:X1=L:GOSUB600:GOSUB1140:GOTO950
260 GOSUB360
270 P=PEEK (&HFF00): IFP=125 ORP=253 THENX=(R-(2*M2)): R5=X:F=M2: GOSUB420
280 IFP=126 ORP=254 THENX=(L-(2*M)):L5=X:F=M:GOSUB420
290 IFY=0 THEN110
300 M1=M:IFM=1 ORM=-32 THENM1=-M1
310 M3=M2:IFM2=1 DRM2=-32 THENM3=-M3
310 H3=H2:1FH2=1 DRH2=-32 THENH3=-H3
320 IFLR<5 ORLR>59 THEN AR=(AR+(1*SGN(32-LR)))+((AR=0 ANDLR>59)*-8)+((AR=7 ANDLR
<5)*8):M=A(AR,0):L1=A(AR,1):L2=A(AR,2):L3=A(AR,3):L4=A(AR,4):GOSUB350
330 IFRR<5 OR RR>59 THEN BR=(BR+(1*SGN(32-RR)))+((BR=0 ANDRR>59)*-8)+((BR=7 ANDR
R<5)*8):M2=A(BR,0):R1=A(BR,1):R2=A(BR,2):R3=A(BR,3):R4=A(BR,4):GOSUB360
335 XL=0: XR=0
340 G0T0150
340 BUTUISO
350 POKEL,L1:POKEL+1,L2:POKEL-31,L3:POKEL-32,L4:RETURN
360 POKER,R1:POKER+1,R2:POKER-31,R3:POKER-32,R4:RETURN
370 FORT=OTO4:POKE&H44D+T,255:POKE&H5AD+T,255:NEXT
380 FORT=OTO192 STEP32:POKE&H484+T,255:POKE&H49B+T,255:NEXT
390 FORT=OTO64 STEP32:POKE&H4CA+T,255:POKE&H4D5+T,255:NEXT
400 POKE&H46D,255:POKE&H471,255:POKE&H483,255:POKE&H49C,255:POKE&H4EF,255:POKE&H
543,255: PDKE&H55C,255: PDKE&H58D,255: PDKE&H591,255
420 FORT2=1T012:Y$=STR$(13-T2):PLAY"V2003":PLAY+Y$
430 IFPEEK(X)>148 AND PEEK(X)<175 THEN510
440 IFPEEK(X)>239 THEN POKEX+F,128:S=225:FORT=1T04:S=390-S:SOUNDS,1:NEXT:RETURN
 460 POKEX, 196
470 X=X-((X<&H420)*512)+((X>&H600)*480)-F
480 POKEOF, 128
490 NEXT
 500 POKEX+F,128: RETURN
510 R5=R5-(T2*F)+F:L5=L5-(T2*F)+F
520 POKEX+F,128:FORT=1T06:FORT1=1T03
530 C=(16*T1)+175:C4=STR*(T1*4):PLAY"V31":PLAYC*
540 IFX=R5 THEN X1=L:GOSUB600:NEXTT1:E=0:NEXT:HR=HR+1
550 IFX=L5 THEN X1=R:GOSUB600:NEXTT1:E=0:NEXTT:HL=HL+1
560 C=128: G0SUB600
570 IFX1=L THENX1=R:C=128:GOSUB600
580 IFX=L5 THEN X1=L:C=128:GOSUB600
600 POKEX1.C:POKEX1+1.C:POKEX1-31.C:POKEX1-32.C:RETURN
630 PRINT"*******************
640 PRINT@160," USING YOUR JDYSTICK YOU HAVE "," TO DESTROY YOUR FRIENDS TANK","
BEFORE HE GETS YOU.BE CAREFUL"," HE MAYBE HIDING AROUND THE "," CORNER......
650 PRINT@352," BE SURE TO CHOOSE YOUR FRIENDS"," WITH CARE!!!
660 PRINT@454,"PRESS SPACE TO PLAY
670 IFINKEY$<>" " THEN670
680 CLS
690 PRINT@65, "PLEASE SELECT GAME: -
700 PRINT@168, "1---BATTLE FIELD
710 PRINT@205, "(IT'S A SHOOT OUT)
720 PRINT@264, "2---HIDE & SEEK
730 PRINT@301, "(MIND THE BARRIERS)
740 PRINT@301, "(MIND THE BARRIERS)
750 PRINT@397, "(BEWARE THE MINES)
750 PRINT@397, "(BEWARE THE MINES)
760 PRINT@456, "4----FORCE FIELD
770 PRINT@493, "(HIDDEN BARRIERS)
780 G$=INKEY*: IFG$=""THEN780
790 IFVAL (G$) <1 DRVAL (G$) >4 THEN780
800 G=VAL (G$): CLS: GOTOB30
680 CLS
800 G=VAL (G$):CLS:GDT0830
810 CLS: GDT0830
820 PRINT@34, "NOW YOU KNOW WHO IS NT YOUR ", " FRIEND... WHY NOT TRY AND ", "GET YOUR OWN BACK!!!!
830 PRINT@165, "PLEASE SELECT:-
840 PRINT@232, "A----AMATEUR
850 PRINT@296, "P----PROFESSIONAL
860 PRINT@360, "E----TO END
870 A*=INKEY*: IFA*="" THEN870
880 IFA$="A" THENPOKE65494,0:GOT0920
890 IFA$="P" THENPOKE65495,0:GOT0920
900 IFA$="E" THENPOKE65494,0:FORT=OTOB:CLST:SOUND(T+1)*25,1:FORT1=1T030:NEXTT1:N
EXT: SOUND25,4: END
910 GOTO870
 920 CLS0
 930 HL=0:HR=0
```

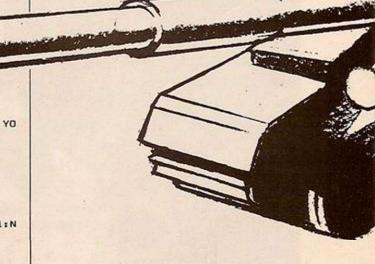
BAT

BATTLE TANKS is a Dragon 32 game for two players using the joystick controls. There is a choice of four options. First is an enclosed screen where each player blasts away at the other tank without any restrictions. However, the tanks have limited shell ranges. In the second version the players have barriers to hide behind to escape from their enemy. However, each can drive or fire off the edges of the picture, returning at the opposite side to catch the enemy unawares.

Minefields, the third option, is displayed on an apparently clear screen. Hidden within the picture are three randomly-positioned mines. If you ride over these mines you are blown up and lose a penalty point. The hidden mines are achieved by Poking on to the picture the value 240. This corresponds to the black in the orange colour set as opposed to the black value 128 normally displayed by the Dragon.

The final option, Force Field, employs the use of the value 240 and Pokes this on to the screen to form invisible walls to negotiate. The object of all the games is to score 10 hits to win. With the hidden mines and walls the player can fire their guns to determine the position of the obstructions as the shell automatically stops when they are detected.

To convert the program from joystick to keyboard operation add in the lines shown. The left-hand tank uses key 2 to go forward, Q-left, W-right, A-fire. The right-hand tank uses the minus sign to go forward, @ to go left, a left-pointing arrow to go right, and Enter to fire.



960 IFG=4 THENGOSUB1010

940 IFG=2 THEN100 950 IFG=3 THENGOSUB1000:GOTO110

DRAGON

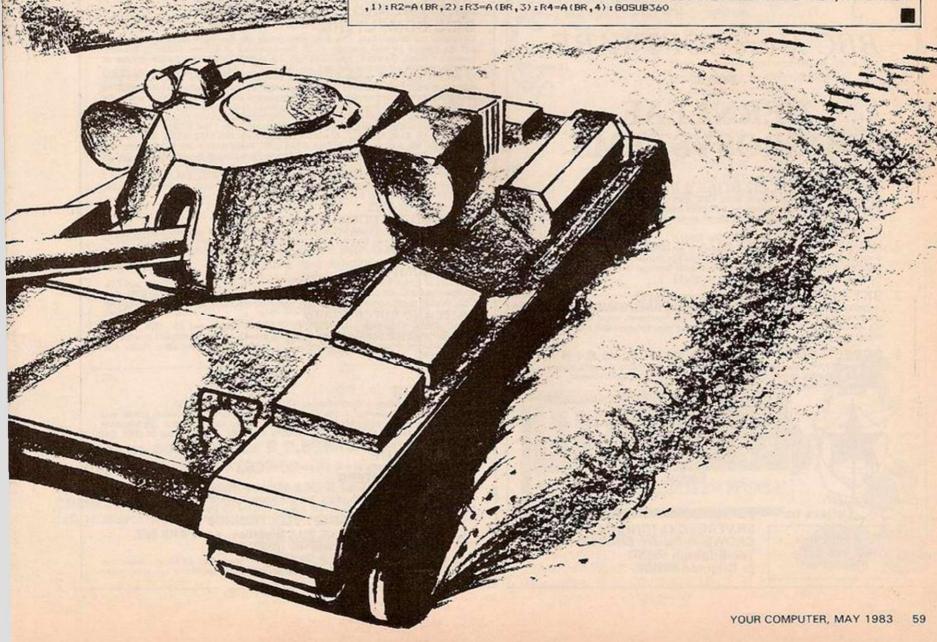
As the steel tide of war rips across the disputed zone, you get your free invitation to take part in the holocaust, courtesy of Vincent Crockett. Can you and the crew of your main battle tank survive?

970 FORT=0T031:POKE&H400+T,255:POKE&H5E0+T,255:NEXT 980 FORT=1T014:POKE&H400+(T*32),255:POKE&H41F+(T*32),255:NEXT 990 GOTO110 1000 CLS0:FORT=0T02:POKE&H421+RND(360),240:NEXT:RETURN
1010 FORT=0T04:POKE&H487+T,240:POKE&H574+T,240:POKE&H50B+(T*32),240:POKE&H45A+(T *32) ,240: NEXT 1020 RETURN 1030 A=42:SOUND4,1:GOSUB1050:A=159:GOSUB1050:A=102:SOUND15,1:GOSUB1050:A=175:SOU ND50,1:GOSUB1050 1040 A=87:SOUND100,1:GOSUB1050:A=255:SOUND4,1:GOSUB1050:A=128:SOUND35,1:GOSUB105 0
1050 POKEX,A:POKEX+1,A:POKEX-1,A:POKEX+32,A:POKEX-32,A
1060 POKEX+2,A:POKEX-2,A:POKEX+64,A:POKEX-64,A
1070 POKEX+31,A:POKEX+33,A:POKEX-33,A:POKEX-31,A:RETURN
1080 PRINT@449,"AGAIN (Y/N) OR CHANGE GAME (C)";
1090 A*=INKEY*:IFA*="" THEN1090
1100 IFA*="Y" THENFORT=1473 T01502:POKET,128:NEXT:GOT0920
1110 IFA*="N" THENA*="E":GOT0900
1120 IFA*="C" THEN680 1130 GOTO1090 1140 PRINT@449, "LOST ONE PENALTY POINT"; 1150 FORT=1T0500:NEXT 1160 FORT=1473T01495: POKET, 128: NEXT: RETURN

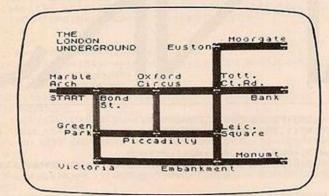
Modifications for joystick control.

170 IFPEEK(340)=254 THENX1=L:C=128:XL=1:GDSUB600 180 IFPEEK(343)=253 THEN X1=R:C=128:XR=1:GDSUB600

180 IFPEEK(343)=253 THEN X1=R:C=128:XR=1:GOSUB600
230 IFPEEK(R-M2)>239 ORPEEK(R-1-M2)>239 ORPEEK(R-31-(2*M2))>239 ORPEEK(R-32-(2*M2))>239 THEN250
270 IFPEEK(33B)=191 THENX=(R-(2*M2)):R5=X:F=M2:GOSUB420
280 IFPEEK(339)=251 THENX=(L-(2*M)):L5=X:F=M:GOSUB420
320 IFPEEK(339)=239 ORPEEK(345)=239 THEN AR=(AR+((PEEK(339)=239))*-1)+(PEEK(345)=239)+((AR=0 ANDPEEK(345)=239)*-8)+((AR=7 ANDPEEK(339)=239)**B):M=A(AR,0):L1=A(AR,1):L2=A(AR,2):L3=A(AR,3):L4=A(AR,4):GOSUB350
330 IFPEEK(33B)=251 ORPEEK(343)=223 THENBR=(BR+((PEEK(33B)=251)*-1)+(PEEK(343)=23))+((BR=0 ANDPEEK(343)=223)*-8)+((BR=7 ANDPEEK(33B)=251)**B):M2=A(BR,0):R1=A(BR,1):R2=A(BR,2):R3=A(BR,3):R4=A(BR,4):GOSUB360



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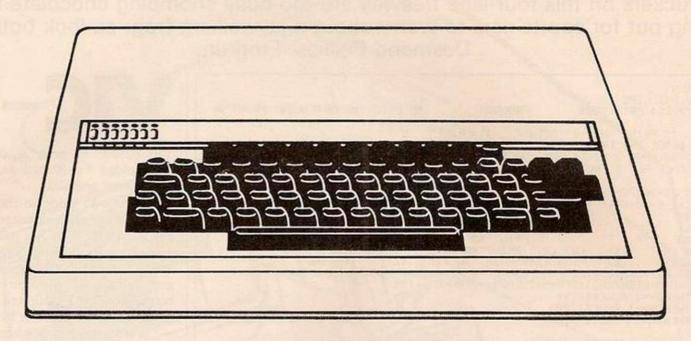
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FROG ON T

The truckers on this four-lane freeway are too busy chomping chocolate bars and watching out for sports cars to worry about a jaywalking frog: so look both ways in Desmond Phillips' Frogrun.

```
REM FROGRUN
REM (C) D.PHILLIPS
POKE36879,254:PRINT"CEM
                                                                                                                                                                     e":PRINT"|軸CONTROLSX|":PRINT"|2
                                                                                                                FROGRUN
OPRINT" | ":PRINT" H + J":PRINT" | ":PRINT" N"
30 PRINT" N DODGE THE TRUCKS AND CATCH THE LOGS!"
40 PRINT"N YOU HAVE 3 LIVES AND 30 SECONDS TO GUIDE YOUR FROG HOME"
50 PRINT"N ONCE ALL 3 FROGS ARE HOME YOUR TIME LIMIT WILL DECREASEM":GOSUB650
60 SC=0:L=3:S1=36876:F1=32:F2=32:F3=32:T%=1800:FT=0
70 OP=32:OC=1:Y=10:X=15:T1$="000000":POKE36878,15
30 PRINT"TE:
90 PRINTTTE:
90 PRINTTTE:
90 PRINTTTE:
90 PRIN
IFA=28THENDY=1 POKES1,190
IFA=43THENDX=-1 POKES1,200
 160
             IFA=20THENDX=1:POKES1.210
170 IFA=20THENDX=1:POKES1,210
180 POKES1,0
190 IFX+DX:IORX+DX:20THEN420
200 IFY+DY:IOTHEN300
210 P=PEEK(7680+X+DX+44*(Y+DY))
220 IFY)1ANDY:GANDP=32THEN420
230 IFY>6ANDP<)32ANDP<)35THEN420
240 IFY+DY=0ANDP<)32THEN420
250 IFY+DY=0ANDP=32THEN520
260 IFDY=0ANDDX=0THEN290
270 POKE7680+X+44*Y.OP:POKE38400+X+44*Y.OC
280 OP=PEEK(7680+X+DX+44*(Y+DY)):OC=PEEK(38400+X+DX+44*(Y+DY)):SC=SC+10
290 X=X+DX:Y=Y+DY:POKE7680+X+44*Y.S5:POKE38400+X+44*Y.5
300 IFY=1ORY=3THENX=X-1:
 300 IFY=10RY=3THENX=X-1
310 IFY=20RY=4THENX=X+1
310 IFY=20RY=4THENX=X+1
320 IFY>5ANDY<10THENPOKE7680+X+44*Y,32
330 POKE2,30:POKE1,44:SYS820:POKE1,88:SYS866:POKE1,132:SYS820:POKE1,176:SYS866
340 POKE2,31:POKE1,8:SYS820:POKE1,52:SYS866:POKE1,96:SYS820:POKE1,140:SYS866
350 P=PEEK(7680+X+44*Y):IFP<>32ANDP<>35THEN420
360 IFY>5ANDY<10THENPOKE7680+X+44*Y,35:POKE38400+X+44*Y,5
370 IFSC>HITHENHI=SC
380 PRINT"T:"TI$" L:"L
390 PRINT"S:"SC"J":PRINT"#DDDDDDDDDDH:"HI":T]"
400 IFTI>TZTHEN420
410 GOTO140
410 GOTO140

420 POKE7680+X+44*Y,OP:POKE38400+X+44*Y,OC

430 POKE7680+DX+X+44*(Y+DY),35:POKE38400+X+DX+44*(Y+DY),2:

440 FORT=15T008TEP-.3:POKES1-1,128+2*T:POKE36878,T:NEXT:POKE36875,0

450 L=L-1:IFL=0THEN470

460 FORT=1T01000:NEXT:GOTO70

470 PRINT"IMMIN ANOTHER GAME [Y/N]?"

480 POKE198,0

490 GETA$:IFA$="Y"THEN60

500 IFA$<\"N"THEN490

510 POKE2.0:SYS2

520 POKE7680+X+44*Y,OP:POKER8400+X+44*Y.OC
 520 POKE7680+X+44*Y,OP:POKES8400+X+44*Y,OC
530 POKE7680+X+DX+44*(Y+DY),35:POKE38400+X+DX+44*(Y+DY),5
540 FORT=1T030:FORG=200T0210:POKES1,G+T:NEXT:POKES1,0
550 FORT=1T01000:NEXT:SC=SC+500
  560 IFX=5THENF1=35
570 IFX=14THENF2=35
  580 IFX=13THENF3=35
590 FT=FT+1:IFFT=3THENFT=0:F1=32:F2=32:F3=32:T%=T%-300:SC=SC+1000
  500 GOTO70
  $10 DATA 165,1,133,251,165,2,24,105,120,133,252,162,20,160,0,177,1,72,200,177,1
   136,145
   620 DATA 1,200,104,145,1,136,177.251,72,200,177,251,136,145,251,104,200,145,251
                DATA 226,96,165,1,133,251,165,2,24,105,120,133,252,162,20,160,20,177,1,72,2
30,177
  540 DATA 136,145,1,200,104,145,1,136,177,251,72,200,177,251,136,145,251,104,200
 145
              DATA136, 136, 202, 16, 224, 96 FORT=820T0913 READK FOKET, K X=X+K NEXT IFXC 12468
THENSTOP
   560 DATA 153,153,126,24,219,189,153,129,7,63,127,127,127,127,63,7,0,255,255,255
   670 DATA 255,255,0,112,254,241,241,241,254,112,255,255,255,255,255,255,255,255,
  680 DATA 7,63,71,71,71,71,63,7,112,254,255,255,255,255,254,112,7
690 POKE56,28:POKE52,28:POKE51,0:POKE55,0:FORT=0T0511:POKE7168+T.PEEK(32768+T)
  680 DATA
 MEXT
   700 FORG=7448T07503 READK FOKEG, K NEXT POKE36869, 255 RETURN
```

VIC-20

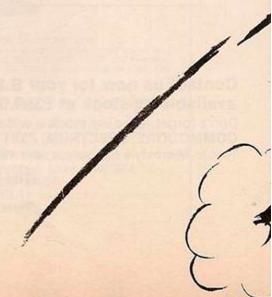
THE GAME Frogrum is designed for the unexpanded Vic-20 and uses machine code and defined graphics.

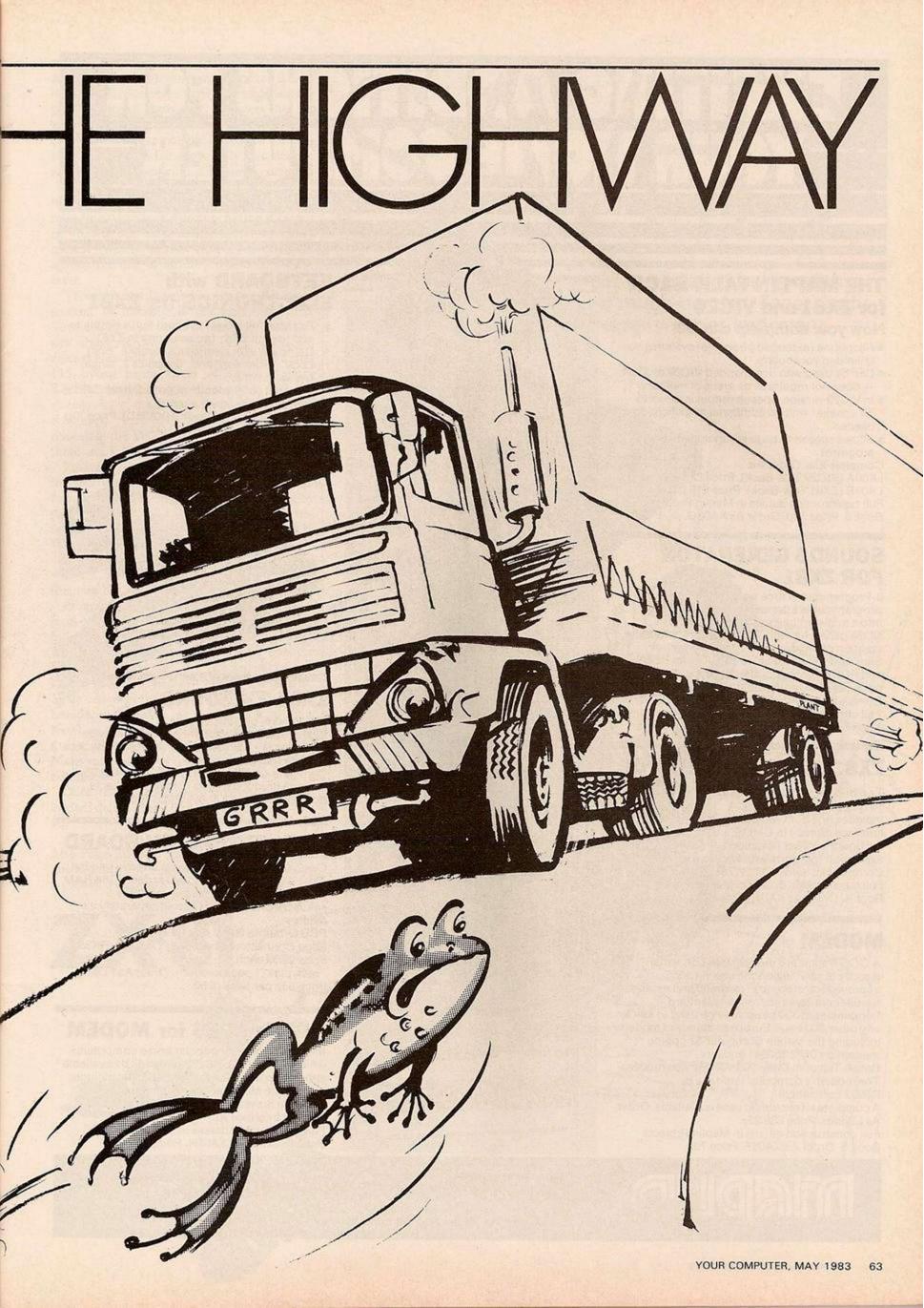
You have to guide an intrepid frog across four lanes of busy highway and safely on to the pavement. He then has to hop between the logs and make it to his home in a gap in the bank. There is a 30-second time limit — this goes down by five when three frogs have made home. You are not allowed near the edge of the screen or on the river bank.

The contest finishes when three frogs have been flattened. A main loop is incorporated and various subroutines. The scrolling is done by two machine-code routines in the cassette buffer at locations 820 and 866. These scroll right and left for one line whose starting address is at location 1 and 2. Unfortunately, the machine code and defined graphics take up a lot of memory as they have to be loaded from Basic.

10-50 Title screen
60-70 Initialise variables
80-130 Print game screen
140-180 Player input
190-260 Check move
270-290 Move frog
300-360 Scroll logs and trucks
370-410 Print Time, Score
420-510 Splat!
520-600 Frog Home!
600-650 Machine-code data
650-700 Defined graphics.

To stop painful crashes, there is an error trap in 650 that checks the sum total of the machine code data and Stops it if there is a discrepancy. The controls U, H, J and N are read by Peeking location 203 and can be changed be reference to the table on page 179 of the Reference Guide. My own personal high score is 13,410.





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AN UNFORTUNATE shortcoming of the ZX-81 is the absence of a tape verify. Considering the poor quality of many tape recorders that get used with ZX-81s, and the widespread use of cassettes that have not been certified for data storage, there is a fair probability that, once in a while, a program will not be saved correctly.

Nothing is more frustrating than spending hours typing in a program, saving it and reloading it at a later date only to find it cannot be loaded due to a saving error. A Verify routine which checks the saved program against the one in memory would be a great asset.

This program is suitable for any ZX-81 — amount of memory is not important. The Verification program is in machine code and sits above RAMtop, thus being protected against New and Load. The program occupies 116 bytes, hence users of small memory ZX-81s should bear this in mind. If users already have machine-code programs above RAMtop, these will not be destroyed or relocated: the Verify program will sit between these and RAMtop.

Program 1 resets RAMtop to accommodate the routine. It looks at the existing RAMtop, reduces it by 116 bytes, then destroys itself by performing New. Because it is self-destructive, remember to Save it on tape before running it! While running, it comes up with:

TO VERIFY RAND USR X where x is a number shown. Make a note of this number — it will be used later.

Program 2 is the verify routine. It sits in a Rem statement in line 1. After typing Rem, a follow it with 116 characters — I usually use 0. To load the machine-code program into the Rem, Run program 2. The machine-code loader used has become pretty standard in Your Computer. Enter the code in hexadecimal, either as a single byte plus Newline, for example, 76 N/L, or as a block at a time for example 7676CD230F plus N/L. Make sure each byte consists of two digits for example 0F and not F.

Once the machine-code program has been loaded, delete lines 10 to 90. Then put in line 10:

10 RAND USR 16632

Also Poke 16510,0. This will change the Rem line number to 0 — a safer approach since line 0 cannot be deleted. Now Save program 2 on (continued on page 67)

SAVED!

Andy Scott helps you attain the goal of better saving on the ZX-81 by providing a much-needed Tape Verify routine — amount of memory is not important.



NEW TITLE

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(continued from page 65)

tape. The two Halt instructions at the beginning of the machine-code program are there to prevent the contents of the Rem statement from being listed. This is preferable for two reasons — one to prevent an awful mess from being listed and, secondly, if the machine-code program is longer than can be listed on to the screen, the ZX-81 will effectively crash.

Now Run the program. It will relocate the routine to above RAMtop, changing three absolute Calls at the same time to the correct address. It will then perform New — thus destroying the Basic program.

Now to use Verify. First put in a Basic program and Save it. Rewind the tape back to the start of the program just saved, then Rand Usr x as a direct command — where x is that number you wrote down from program 1 — remember? Now press Play on the tape recorder. Three types of report code can be shown:

0/0 program verified and is OK D/0 Break key pressed during Verify E/0 Error has been found on tape.

D/0 is similar to when Break is pressed during normal Load and Save. Note the use of E/0 — Sinclair does not use this report code. If an error has been found, your original program has not been destroyed — try listing it! Just re-Save the program and do Verify again.

The Verify routine does not check if system variables have been saved satisfactorily — during Verification many would be different to when saved. In between saving and verifying, do not change any user variables or define new ones — they would be different to those stored on tape and an error would be shown. The Verify program can be used within a Basic program also, for example: 100 SAVE "EXAMPLE"

110 PRINT "REWIND TAPE TO START OF EXAMPLE"

120 PRINT "THEN PRESS PLAY ON TAPE RECORDER"

130 PRINT "PRESS G KEY WHEN YOU HAVE DONE THIS"

140 IF INKEY\$ <> "G" THEN GOTO 140

150 RAND USR X

Where X is the start of the Verify program

— again the one you wrote down.

Program 1. 10 LET X-PEEK 16388+256#PEEK 16389 20 LET X=X-116 30 LET T=X/256 40 LET H=INT T 50 LET L=(T-H)#256 60 POKE 16388,L 70 POKE 16389,H 80 PRINT "TO VERIFY USE RAND USR ",X 90 PRINT " PRESS ANY KEY TO CONTINUE PRESS ANY KEY TO CONTINUE 100 IF INKEY\$="" THEN GOTO 100 110 NEW Program 2. 1 REM (fill this with 116 characters) 10 LET X=16514 20 LET A\$="" 30 IF AS="" THEN INPUT AS 40 IF AS="S" THEN STOP 50 POKE X,16*CODE A\$+CODE A\$(2)-476 60 PRINT AT 11,7;X;" ",A\$(1 TO 2) 70 LET X=X+1 80 LET A\$=A\$(3 TO) 90 GOTO 30 RUN (in FAST)

```
The Verify routine in machine code.
4982
                 76
                            HALT
                                                     To prevent screen listing
4083
                            HALT
                 76
4084
                 CD230F
                            CALL 0F23, FAST
                            SCF
                 37
4088
                 CB12
                            RL
408A
                 CBOA
408C
      NEXT PROG
                 CD9140
                                 4091, INBYTE
                            CALL
                                                     Start tape listen
408F
                 18FR
                            JR
                                 408C, NEXT PROG
      IN BYTE
4091
                 0E01
                            LD
                                 C.01
4093
      NEXT BIT
                 0600
                            LD
                                 B,00
4095
      BREAK1
                 3E7F
                            LD
                                 A,7F
4097
                 DBFE
                            IH
                                 A, (+FE)
                                                     Test for BREAK key
4099
                 DSFF
                            OUT
                                 (+FF),A
                                                     Echo to screen
409B
                 1F
                            RRA
                                 C,4083,CONT1
489C
                 3805
                            JR
                                                     JR if BREAK not pressed
409E
      BREAK2
                 CD288F
                            CALL 0F2B, SLOW
40A1
                 CF
                            RST
                                 BBH
                                                     : ) REPORT CODE D
40A2
                            DEFB ØC
                 9C
                                                     ; ) BREAK key pressed
                 17
40A3
      CONT1
                            RLA
40A4
                            RLA
40A5
                 3834
                            JR
                                 C,400B,GET BYTE
                                                     JR Build up byte in C Reg.
48A7
                 10EC
                            DJNZ 4095, BREAK1
4089
                 F1
                            POP
40AA
      PROG NAME CD9140
                            CALL 4091, IN BYTE
                                                     Load built up byte into A
40AD
                 79
                            LD
                                 A,C
40AE
                 17
                            RLA
                                                     Bit 7 of byte into Carry
40AF
                 30F9
                                 NC,40AA,PROG NAME
                                                     ;JR if not last byte of name
                            JR
40B1
                 210940
                            LD
                                 HL,4009, VERSN
                                                     Start loading from 4009
40B4
      VERIFY
                 CD9140
                                 4091, IN BYTE
                                                     Byte from tape into C reg.
                                                     Start of Basic prog. into DE
40B7
                 117940
                            LD
                                 DE,4079
40BR
                 87
                            AND
                                                     Clear carry
40BB
                 E5
                            PUSH HL
                                                     Save address count
40BC
                 E052
                            SBC
                                 HL DE
                                                     Are we up to Basic prog?
40BE
                            POP
                                                     Retrieve address count
                 E1
                                 HL
40BF
                 3884
                                 C,48C5,CONT2
                                                     And if not, do not verify
                            JR
40C1
                            LD
                                                     Byte from tape into A
40C2
                 BE
                            CP
                                 (HL)
                                                     Do Byte VERIFY
                                                     JR ERROR if verify false
40C3
                            JR
                 2011
                                 NZ,40D6,ERROR
4905
      CONT2
                 23
                            INC
                                                     ;HL points to next address
                                 HL
                 ED581448
4006
                            LD
                                 DE, (E-LINE)
40CA
                 87
                            AND
                                                     Clear carry
40CB
                 E5
                            PUSH HL
                                                     ;Save address count
4ecc
                 E052
                            SBC
                                 HL, DE
                                                     Are we up to E-LINE?
40CE
                                                     ;Retrieve address count
40CF
                 20E3
                                 NZ,40B4, VERIFY
                                                     And if not cont. to verify
40D1
                 CD2B0F
                            CALL 0F2B, SLOW
4904
                 CF
                            RST
                                 08H
                                                     ;)No errors -
                                                     ; > REPORT CODE 8
4005
                 FF
                            DEFB FF
40D6
      ERROR
                 CD2B0F
                            CALL 0F2B, SLOW
                                                     :)ERROR -
40D9
                 CF
                            RST
                                 08H
400A
                 00
                            DEFR OD
                                                     ,>REPORT CODE E
40DB
      GET BYTE
                 05
                            PUSH DE
40DC
                 1E94
                            LD
                                 E,94
40DE
      TRAILER
                 061A
                            LD
                                 B,18
                                                        Loops
40E0
      COUNTER
                 10
                            DEC
                                 E
                 DBFE
40E1
                            IN
                                 A. (+FE)
                                                     :Pick up tape signal
40E3
                 17
                            RLA
                 CB7B
40E4
                            BIT
                                 7,E
40E6
                                                     , Build up
                 7B
                            LD
                                 A,E
                 38F5
                            JR
                                 C,40DE,TRAILER
                                                        Byte in
                 10F5
                            DJNZ 40E0, COUNTER
40E9
                                                        C Register
                            POP
40EB
                 D1
                                 DE
40FC
                 2004
                            JR
                                 NZ.40F2.BIT DONE
40EE
                 FE56
                            CP
                                 NC.4093, NEXT BIT
40F0
                 30A1
                            JR
40F2
      BIT DONE
                 3F
                            CCF
                 CB11
40F3
                            RL
40F5
                 309C
                                 NC,4093, NEXT BIT
                            JR
40F7
                 09
                            RET
      BLOCKMOVE 280440
40F8
                            LD
                                 HL. (RAMTOP)
                                                     ;Put address of RAMTOP in HL
40FB
                 010000
                            LD
                                 BC,000D
40FE
                 09
                                 HL,BC
                                                     ;address for INBYTE in HL
                            ADD
40FF
                 228048
                            LD
                                  (408D) .HL
4102
                 22AB48
                            LD
                                  (40AB),HL
                 228540
                                  (4085),HL
4105
                            LD
4108
                 218440
                            LD
                                 HL,4084
                                                     ; )Transfer programme
410B
                 ED580440
                                 DE, (RAMTOP)
                                                     ; ) (4084 to 40F7)
                            LD
410F
                 017400
                            LD
                                 BC,0074
                                                     ; )to above RAMTOP
4112
                 EDB0
                            LDIR
                            CALL 03C3, NEW
                 CDC303
      Users of old Sinclair ROMS note the following changes:
          4084-4086
                      CD200F
          409E-4090
                      CD280F
                      CD280F
      Or alternatively, load the machine code programme as described above,
then POKE 16517,32; POKE 16535,40; POKE 16594,40; POKE 16599,40
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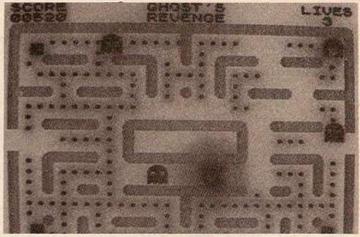
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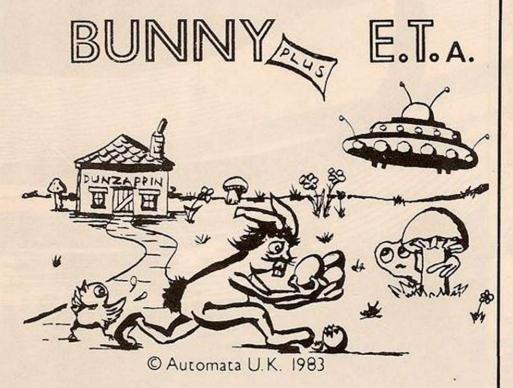
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1 REM SATURN LANDER
2 REM © G. DUEN, MARCH 1983
3 GO TO 20
10 PLOT SX,SY: PLOT SX,SY+1: D
RAU 3,0: PLOT SX+3,SY: PLOT SX+1
,SY+2: PLOT SX+2,SY+2
11 RETURN
20 PREFER 0: RODDER 0 PAPER 0: BORDER 0: INK 5: C OVER 1 PLOT 0,0: DRAW 10,20: DRAW 0: DRAW 8,6: DRAW 14,-10: DR 20 LS -10: DR AW 6,4
22 DRAW 4,-4: DRAW 8,6: DRAW 1
4,-10: DRAW 15,0
24 DRAW 0,1: DRAW -16,0: DRAW
OVER 0;16,-1
26 DRAW 14,6: DRAW 4,-4: DRAW
18,8: DRAW 6,-2: DRAW 3,4
28 DRAW 10,-10: DRAW 10,6: DRAW
30 DRAW 10,-10: DRAW 24,14: DR
W 8,12: DRAW 10,-8: DRAW 3,4
30 DRAW 16,-10: DRAW 24,14: DR
AW 8,-10: DRAW 4,2: DRAW 3,-10
32 DRAW 10,-4
35 RANDOMIZE: FOR S=1 TO RND;
100: LET L=USR 32300: NEXT S
40 LET R\$="AB CD AB CD AB
CD AB AD CB"
45 PRINT AT 12,0; R\$; AT 15,0; R\$
PRINT AT 17,0; R\$
50 LET R\$="EFG KLM KLM EF
HIJ NOP NOP HI
J HIJ NOP S5 PRINT INK 5; AT 4,0; R\$; AT 8,0; R\$ DR PRINT INK 5; AT 4,0; R\$; AT 8, Ø; R\$ LET SX=RND #100+75: LET SY=1 85 51 LET HU=0: LET UU=0 52 LET 5=0 64 GO SUB 1 (5X,5Y-1).+POINT (5 T (5X+2,5Y-1)=3 TH 65 X+1,SY-1) +POINT (SX,SY-1).+POINT (S X+1,SY-1) +POINT (SX+2,SY-1) =3 TH EN GO TO 2000 66 LET OSX=SX: LET OSY=SY 67 LET SX=SX+HU 68 LET SY=SY-UU: IF SY>16S THE UU =0 LET 59 LET NSA-SY=DS; 5X=OSX: LET SY=DS; 70 GO SUB 10 71 LET SX=NSX: LET SY=NSY; 72 LET S=S+1-(INKEY\$<)"") 75 LET L=USR 32200 LET L=USR 32200 LET HV=HV+.25*((INKEY\$ LET NSX=SX: LET NSY=SY: LET SX: LET SY=OSY GO SUB 10 76 LET HU=HU+.25*((INKEY\$="2" AND SX(250 AND HU(=3)-(INKEY\$="1" "AND SX)2 AND HU)=-3)) 77 LET UU=UU+.25-.5*(INKEY\$="0" 78 INPUT "": PRINT #1; "UERT.UE L="; INT (UU+100) /100, "HOR.UEL="; INT (HU+100) /100 80 IF POINT (5X,5Y) +POINT (5X, 5Y+1) +POINT (5X+1,5Y+1) +POINT (5 X+1,5Y+2) +POINT (5X+2,5Y+1) +POIN T (5X+2,5Y+2) +POINT (5X+3,5Y) +PO INT (5X+3,5Y+1) (>0 THEN GO TO 10 00 200 GO TO 64 1000 FOR F=0 TO 30: T (F/2)): INA 2: PL 200 GO OUER (F/2=IM PLOT T (F/2)): INA 2: PLOT SX,SY: DRA W 3,2 1010 PLOT SX,SY+2: DRAW 3,-2 1020 OUT 254,55*(F/2=INT (F/2)) 1030 NEXT F 1035 INK 7 1040 OUT 254,0 1050 PRINT OVER 0;AT 10,11; FLAS H 1; "GAME OVER" 1055 PRINT TAB 11; "SCORE=";S 1050 STOP -2000 IF ABS HV).25 OR SY)5 THEN CO TO 1000 FOR X=10 TO 50 STEP 2010 5: 1,X: N 015 INK PRINT AT 10,12; FLASH 1; "WE 2020 LL DONE"
2030 PRINT TAB 11; "SCORE="; 200-5 9 PRINT "PLEASE WAIT WHILE DA 8999 9000 RESTORE 9000: FOR U=0 TO 12 READ DATUM: POKE USR "A"+U, 9010 DATUM: NEXT U 9020 DATA 0,15,31,31,63,63,7,0,0



SATURN LANDER

Landing on the surface of the planet Saturn from an equatorial orbit is not an easy number. Garry Owen's 16K Spectrum program will help you run rings round space pilots who boast about working in the asteriod belt.

YOU ARE IN command of the first manned mission to Saturn. Your object is to land on the planet's surface but to get there you have to navigate through the rocks which make up Saturn's rings whilst compensating for the strong gravity.

The program, for a 16K Spectrum, is mainly Basic but four machine-code routines are used. The routine at 32000-32024 scrolls one line right to left by one pixel and the routine at 32100-32139 scrolls one line left to right by one pixel.

Each of these needs the address of the first byte of the top row of the line to be scrolled supplied to it in the hl register to work.

The routine at 32200-32242 calls the two scroll routines and provides the correct addresses. This moves the rocks. The routine at 32300-32318 positions the landscape so that the landing pad is a random number of pixels from the edge of the screen.

The data for the machine-code routines is held in Data statements, in hexadecimal, in lines 9610-9640 and Poked into memory by lines 9500-9590 after RAMtop has been lowered to 31999 — lines 9500 and 9600.

The data for the user-defined graphics — lines 9020-9070 — is Poked into place by lines 9000 and 9010. Note that the capital letters in lines 40 and 50 are the graphics characters on those keys.

Type in the program as shown and before attempting to Run it, Save it so that it autoruns from line 8999 on Loading, that is

SAVE"SATURN"LINE 8999

This ensures that all the data is set up before the program is Run. Verify it, New the program and reload. You should get the message

PLEASE WAIT WHILE DATA IS POKED

The program is now ready to run.

The controls are:

1 to accelerate to the left

2 to accelerate to the right

0 to accelerate upwards

Note that if you are already moving in the opposite direction to that which you want to go, you will slow down first. Watch the velocity readings at the bottom of the screen.

The remaining program structure is as follows:

10-11 draw lander

20-35 draw landscape and move it

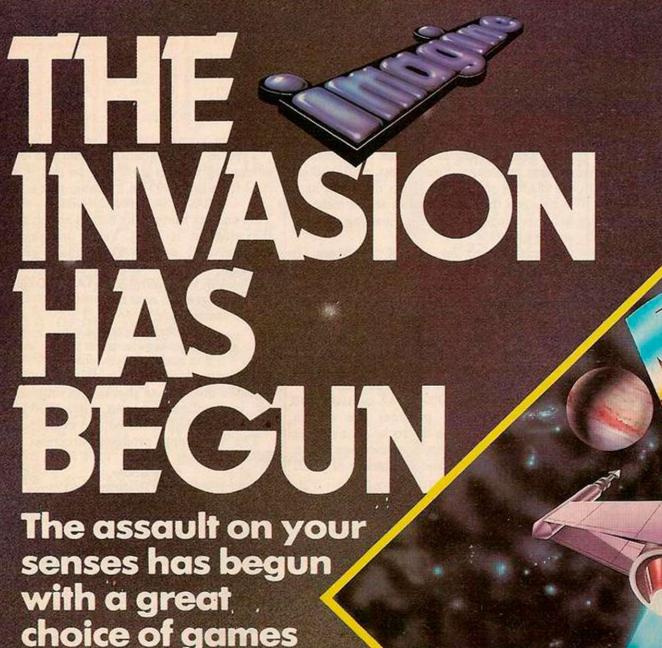
40-55 prints rocks on screen

60-62 initialise variables

64-200 main program 1000-1060 crash routine

2000-2030 successful landing routine

The variables used are SX and SY which give the co-ordinates of the lander, and HV and VV — horizontal and vertical velocities.

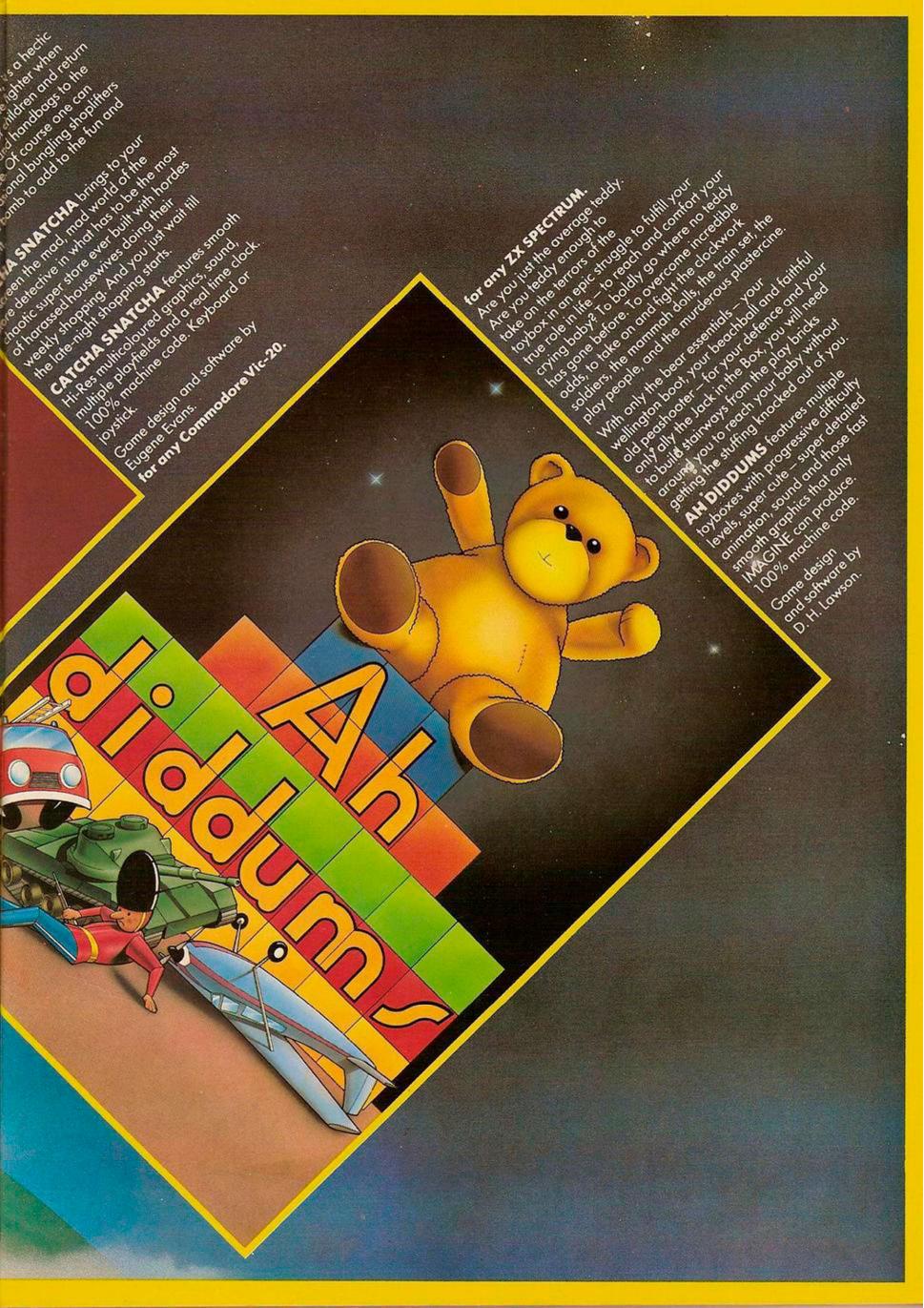


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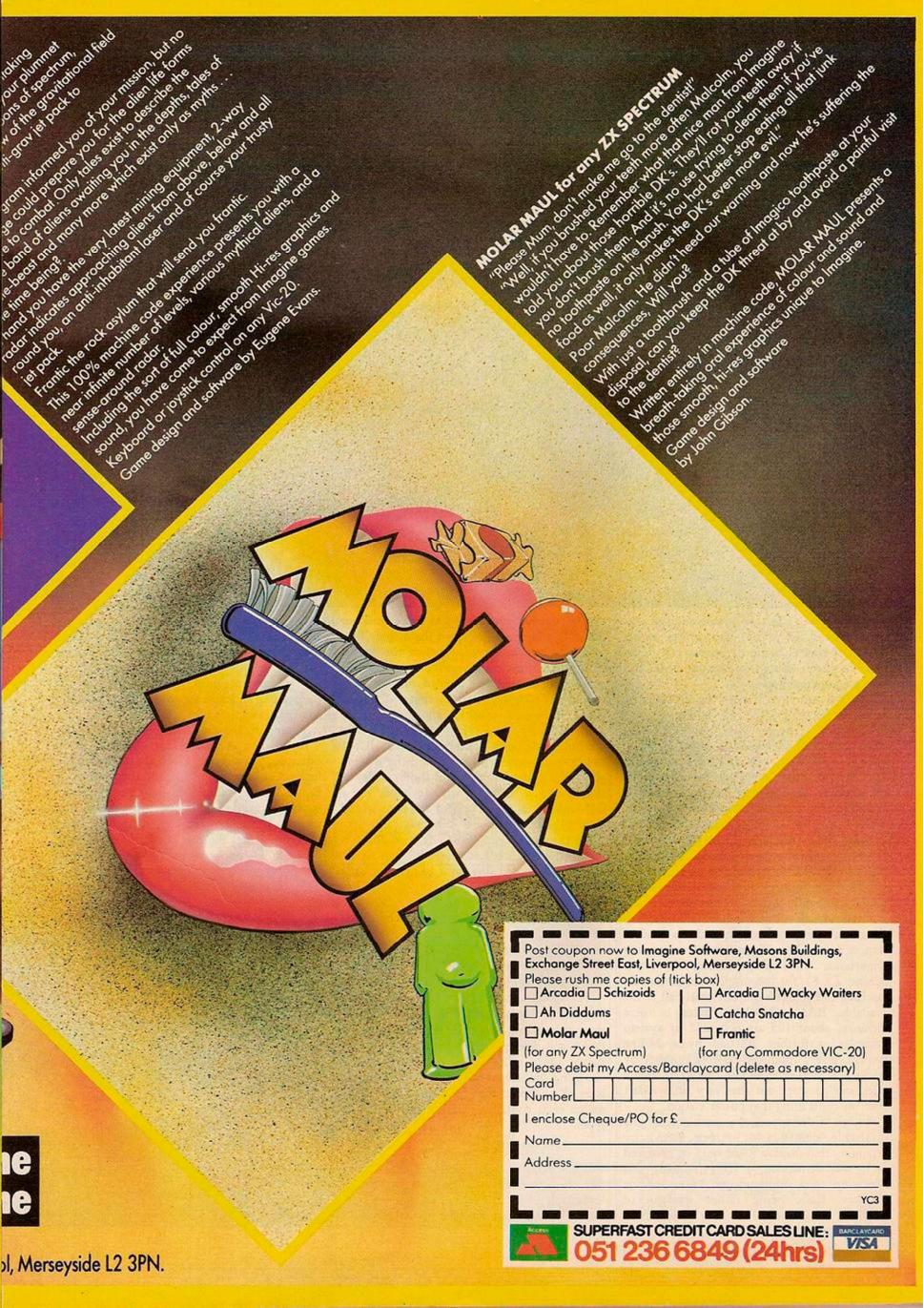


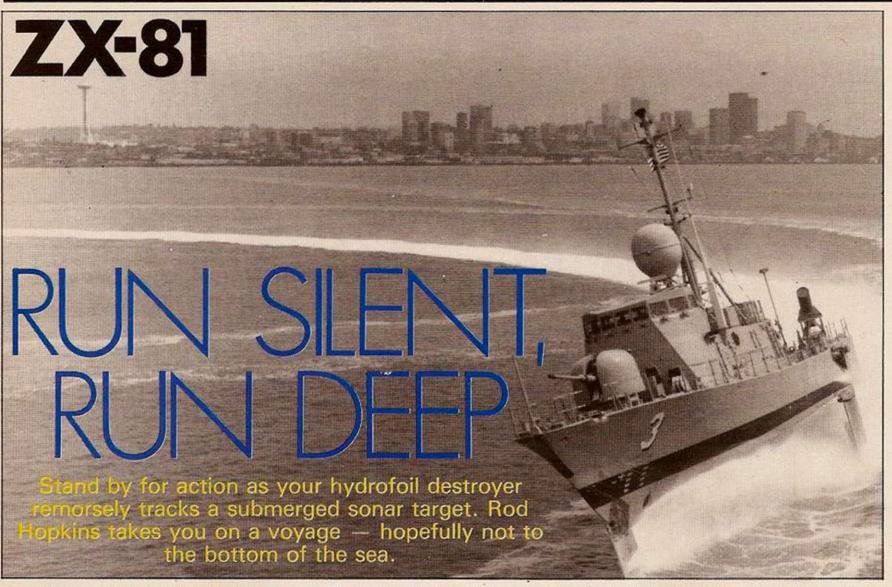












A DESTROYER LURKS on a storm-tossed sea, lying in wait for passing submarines — the object, of course, being to destroy one. This game has been written in machine code, and uses imaginative display.

The first and most obvious benefit accruing from the use of machine code is that of speed of execution. Basic is a general-purpose, high-level language designed to cope with an infinite variety of programming needs. A machine-code programmer, on the other hand, can confine his attention to the particular needs of the moment. The result is that a lot of time-consuming classification of tasks, of fetching and carrying can be avoided. A Basic program is ultimately performed as a machine-code sequence of course, but an awful amount of sorting and organising must be carried out by the interpreter during its execution.

A second, and directly-related advantage to be gained from writing in code is that of compactness. This factor is of overriding importance when programming the unexpanded ZX-81, for the simple reason that the machine can arrogate to itself nearly all of the available RAM. Of 1024 bytes of user memory, about 125 are occupied by system variables; a further 700-odd by a 22-line display, and a smallish, variable number by stacks and marker bytes. You will not need a calculator to work out that very little is left over for controlling that power station.

Sinclair sidestepped the problem of the insatiable demands of screen RAM by arranging that display RAM only be allocated as it was demanded, a CLS reducing this allocation to a minimum of 25 end-of-line markers. Basic being rather wasteful of memory, programmers in that language for

the 1K machine are forced to make constant use of this facility to contract the display file.

The technique is this: to clear the screen each program cycle and reprint the display, in order that unused but opened display lines should not accumulate an overhead of wasted RAM. Economy results, but unfortunately with a fairly paralysing strobe-effect. In machine code, a sufficiency of display RAM can be permanently opened, and the display given a feel of continuity and fluidity. Naturally, if enough memory were to hand, and a fast interpreter, then the pros and cons would need to be reargued.

For the current program, a decimal dump is provided in figure 1, disassembled in figure 2. It will be noted that some use of Sinclair's ROM has been made.

The first address shown in the dump is 16514, indicating that the code is to be stored in a Rem statement occupying the first Basic line of the program. Therefore, type:

1 REM 110 CHARACTERS . . . whichever you like.

Having done this, type

PRINT PEEK 16511

the result should be 112. If it is not, then edit line 1 and delete or add characters as appropriate. Once line 1 is correct, edit it twice, changing the line number to 2 and 3 respectively. You should now have three Rem statements each containing 110 characters. Now type:

POKE 16511,88 POKE 16512,1

and in effect, a single Rem statement having 342 characters remains. The stage is now set for entering the machine code. To prevent an unbreakable listing loop occurring after the

code has been entered, the two first characters Poked will be Newlines, or end-of-line markers. This has the effect that the default list line will always be line one. However, to list subsequent lines, simply type List 2. Remember to delete the loader when entering has been completed.

Typing in the code using the loader of figure 4 should not take more than about 10 or 15 minutes, forbidding though the dissassembly looks. As bytes are entered, the format of figure 1 is reproduced on the screen to allow straightforward checking of each entry as it is made.

Figure 3 lists the massive Basic part of the program. Do not be tempted to add frills; they

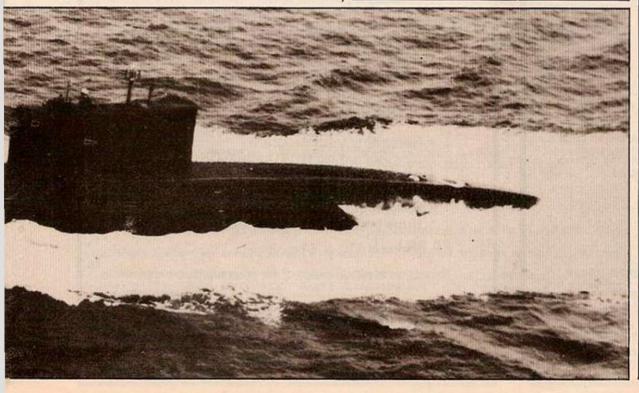


	100				and the latest the same of the
Figure	1.			No.	
Figure 16514 16529 16524 165234 165234 165234 165344 165534 165534 165541 165591 16549 16549 165694 165694 165694 166614 166694 166694 166694 166694 166694 166794 166794 167794 167784 167784 167784 167784 167784 167784 167784 167784	123475 3559 123475 3559 123476 3554 1325159 13	11745 11745	47 4 5 5 6 7 2 6 9 6 7 3 1 5 4 5 7 8 9 1 6 6 2 2 2 5 6 7 6 6 7 2 4 5 2 6 7 2 6 9 6 7 2 4 5 2 6 7 2 6 9 7 2 6 9 6 7 2 6 9 6 7 2 6 9 7 2	2 355 77 5 6 6 95 9 5 9 6 8 3 1 1 5 2 5 6 4 2 5 6 5 6 5 7 6 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	5454 55 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5

will almost certainly lead to an out of memory report.

Keyboard decoding has been arranged to suit the destroyer skipper wearing regulation Arctic-issue mittens: any key 1 through 5 will move the ship left, while any key 6 to 0 will move it to the right. Pressing F releases a depth charge. As normal, these devices are set to trigger at the supposed depth of the submarine. This particular destroyer has excellent sonar; its charges always go off at the appropriate depth. They must, however, drop into the conning tower to produce the desired effect. To alter the speed at which events take place, try Poking different values into address 16767.

Figure 2. U-BORT HU	NT DISSASSEMBLY
INITSCRN	LD HL, (DISPLAY FILE) PUSH HL LD DE,7 ADD HL,DE LD (DFCC),HL
ZEROACC	XOR A RST 10H DJNZ ZERCACC
PRTACC	LD A,CODE """ RST 10H DUNZ PRIACC:
BLANKLNS	LD BC,256 XOR A RST 10H DEC BC
INITSHIP	OR C JR NZ, BLANKLNS POP HL LD E, S1 ADD HL, DE LD (SHIPAD), HL
NEUSUB	LD A,255 LD (SUBCOUNT),A LD HL, (RAND) INC HL LD (RAND),HL
PRTSUB	LD A, (HL) LD HL, SUBCOUNT INC HL AND 7 INC A LD (SUBLINE), A ADD 7 LD (HL), A LD C, 26 CALL PRTPOS LD HL, (DFCC) LD (SUBAD), HL LD HL, (SUBAD) PUSH HL LD B, 5 LD (HL), C INC HL DJNZ -4 POP HL LD A, (HL) CP NEULINE JRZ NEUSUB LD B, 5
URVES	LD (HL), CODE """ INC HL DJNZ -S DEC HL DEC HL DEC HL LD (HL), CODE "B" LD A, (FRAMES) AND 38 LD C,A LD B,8 CALL PRIPOS LD HL, (DFCC) LD HL, (DFCC) LD A, (HL) CP """ LD A, CODE """ JR Z,1
MOUESHIP ACTION?	JR Z,1 DEC A LD (HL) ,A LD B,2 PUSH BC LD HL, (SHIPAD) LD A, (LAST-K)



```
CP 247
JR NZ,RIGHT ?
DEC HL
LD A, (HL)
CP NEULINE
JR Z,DCHARGE
LD (SHIPAD),HL
CALL PRTSHIP
CP 239
JR NZ,DCHARGE
INC HL
LEFT ?
RIGHT ?
                                                                                                                                                  THE STATE OF THE S
JUMP
DCHARGE
 DCHARGE?
 BLANKDC
 PRTDC
 STODE
   DELAY
 PRTSHIP
     PRTBLK
     EXIT
           Figure 3.
     BASIC PROGRAMME
10 PRINT USR 16516;
" SUBS ESCAPED"
15 INPUT A$
20 RUN
        Figure 4.
        LOADER ROUTINE
   LOADER ROUTINE

10 FOR N=1 TO 338 STEP 5

15 SCROLL
20 PRINT 16513+N;
25 FOR K=0 TO 4

30 INPUT I

35 POKE 16513+N+K, I

40 PRINT THE (7+K+5); I;

45 IF N+K=338 THEN STOP

50 NEXT K

55 PRINT

60 NEXT N
```

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The Breakout program. 10NERROR RUN 10*TV255,0 20MODE7 30 PROCSETUP 40PROCCOURT 50CALLPIP 50CALLPIP 60PRINTTAB(24,0); !S%; :IF?BC(54 AND?BY(21 GOTO50 70TIME=0:REPEAT SOUND &12,-8; TIME,5: UNTIL TIME>200 80SOUND&11,-15,0,5: IF ?BC=54 ?XV=?XV *(2*RND(2)-3):?YV=255: GOTO40 90?YV=0-ABS(?YV):BLX=BLX-1:PRINTTAB(37,0);BL% 100IF BLX>0 ?XV=ABS(?XV):GOTO50 110 IF !S%>HI_SCORE HI_SCORE=!S% 120PRINTTAB(3,16)CHR\$133"HIT 'G'-ANOTHER GAME OR"CHR\$151; TAB(2,17)CHR\$134"'ES APE'-START FROM BEGINNING"CHR\$151; 130IF NOT INKEY(-84) GOTO130 140?XV=(2*RND(2)-3):?YV=255:?WS=1:BLX=BALLS%:!(8%)=0:GOTO40 150DEF PROCCOURT:LOCAL IX,J% 155CLS 155CLS 160IF ?WS<11 AND ?BC=54 ?WS=?WS+2 170CLS:PRINT:FOR I%=0 TO 22:PRINTCHR\$152:NEXT 180PRINTTAB(1,1)STRING\$(38,CHR\$112) 198 190 200FORIX=2 TO23:PRINTTAB(1,IX)CHR\$181;TAB(38,IX)CHR\$234;NEXT 210FORIX=?WS+2 TO ?WS+7:PRINTTAB(2,IX)STRING\$(36,CHR\$124):NEXT 220FORIX=1 TO ?WS +1:PRINTTAB(0,IX)CHR\$151:NEXT 230RESTORE:FOR IX=1 TO 6:READJX:PRINTCHR\$JX:NEXT 240REPEAT:PRINTCHR\$151:UNTIL VPOS=23 250 DATA147,150,146,149,145,148 260T%=RND(15)+2 2707BC=0:?BP=19:?PB=39:?DB=1:PRINTTAB(19,21);CHR\$42;STRING\$(?BL-1;CHR\$47);CHR\$ 280?BX=T%:?LX=T%:?BY=20:?LY=20:?PX=T%*2:?PY=60:?DX=0:?DY=0:PRINTTABKT%,20)CHR\$ 290PRINTTAB(1,0)CHR#131;"HI_Score:";CHR#135;HI_SCORE;TAB(16,0)CHR#133;"Score:";CHR#134)!S%;TAB(29,0);CHR#130;"Balls:";CHR#131;BL% 300REPERT UNTIL INKEY(-99) 310ENDPROC 33 320DEF PROCSETUP 3300SWORD=&FFF1:OSWRCH=&FFEE:OSBYTE=&FFF4 340VDU23;8202;0;0;0; 350DIM DOT 5,71 0,72 0,73 0,74 0,8% 0,8% 0,8% 0,8% 0,8% 0,4% 0,4% 0,88 0,88 0,88 0

B B C

Chris Melville's last two articles delved into the BBC operating system — now you can break out.

THE PROGRAM published here is a Basicdriven assembly language program to play either Breakout or Breakthrough. It uses pixel graphics in Mode 7 so that it should run on a model A if you miss out all the comments and put multiple assembler statements per line. Using pixels in mode 7 needs some fiddling which would slow down a Basic program too much to make a challenging game, but this one is both fast and smooth. It was intended as an example of how the MOS calls would be used in games programming. There is not a direct memory reference in the whole program unusual for a game - so the program will run on any operating system and also with the 6502A second processor installed. The features are: selectable bat size, increasing game speed as score increases, selectable initial hardness, selectable bat speed relative to ball, selectable number of balls per game, wall lowers every time you get through the last one, breakout or breakthrough, and high score.

Some of the operating system calls are as follows:

Purpose
Produce a beep
Perform Tab
Examine character at
cursor position.

(listing continued on page 83)

Line MOS numbers routine 680-710 OSWORD(7) 950-1000 OSWRCH(31)

1020-1030 OSBYTE(135) (continued on page 83)

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```
(listing continued from page 81)
BV 0,BC 0,BEEP 8,WS 0,S% 3,DX 0,DY 0,DB 0,LX 0,LY 0,SPEED 0,THRU 0,LEVEL 15
3607D0T=161:7(D0T+1)=162:7(D0T+2)=164
3707(D0T+3)=168:7(D0T+4)=176:7(D0T+5)=224
380!(BEEP)=%FFF10011:!(BEEP+4)=%5000F
3907SPEED=30:!S%=0:7WS=1:7XV=1:7YV=255
400PITCH=BEEP+4:HI_SCORE=0
    410 PROCASSEMBLE
420PROCINSTRUCTIONS
    430ENDPROC
   430ENDPROC

440DEF FNGETBETWEEN(I%,J%):LOCAL K%

450 PRINT" (";I%)" to ";J%;">";CHR#135;

460REPERT:K%=GET-ASC"0":UNTIL K%>=I% AND K%<=J%

470PRINTCHR#(K%+ASC"0")
    488 K%
   BALLS%
   SAUPRINT'CHR$130; "Input initial bat size"; :?BL=FNGETBETWEEN(1,5)
540PRINT'CHR$130; "Input bat speed "; :?BV=FNGETBETWEEN(1,4)
550PRINT'CHR$130; "Hit 0 for breakOUT, T for breakTHROUGH"; REPEAT X$=GET$; UNTIL

$="0" OR X$="T":IF X$="0" ?THRU=0 ELSE ?THRU=255

560PRINT'CHR$134; "Input initial game speed"; :HX=FNGETBETWEEN(1,3)

570 PRINT'CHR$136; "Z-bat left, X-bat right, SPACE BAR-serve";

580 PRINT'CHR$136; "key to start..."
  580 PRINT' CHR$136)
  590 X=GET
6001F H%=1 !(LEVEL)=&1E23282B:!(LEVEL+4)=&18191A1C:!(LEVEL+8)=&12131416:!(LEVE
L+12)=&080C0F11 ELSE!(LEVEL)=&18191A1C:!(LEVEL+4)=&12131416:!(LEVEL+8)=&080C0F11
:!(LEVEL+12)=&080C0F11
610IFH%=3 !(LEVEL)=&12131416:!(LEVEL+4)=&080C0F11:!(LEVEL+8)=&080C0F11:!(LEVEL
+12)=&080C0FF11
   620ENDPROC
630DEF PROCASSEMBLE:LOCAL PASS%
640DIM FREE%2000
650FOR PASS%=0 TO 2 STEP2
660P%=FREE%
   6607 PREEX
670E OPT PASSX
680.PIP LDX #BEEP MOD 256
690 LDY #BEEP DIV 256
700 LDA #7 SET UP OSWORD
710 JSR OSWORD DO A BEEP
    720 BALL LDA PX
                                             VEIND NEW
    730JSR DELAY
                   CLC
ADC XV
STA PX
LDA PY
CLC
ADC YV
    748
                                              MIXEL
   758
                                             OF BALL BY
ADDING ON
X,Y VELOCITY
                                             SOF
    770
780
790
                                                TO OLD POS.
    800
                    STA PY
    810
                    LDB PX
                                              WORK OUT THE
    828
                                             POSITION OF
                    LSR A
STA BX
    830
    850
                   LDA PY
LDY #255
INY SEC
SBC #3
BCS SUB
                                             WORK OUT TAB
   879
                                             POS. OF Y
COORD. OF
BALL AND ITS
    888. SUB
    890
    900
                                         PIXEL HEIGHT
    910
                    CLC ADC #3
                STY BY
920
                   STR DY
   938
   940
                   LDA #31
JSR OSWRCH
LDA BX
    950
                                             CODE FOR TAB
                                              MOVE TO X,Y
   978
                   JSR OSWRCH
LDA BY
    988
                                             POS. OF BALL
    990
                    JSR OSWRCH
  1000
                   LDR #135
                                              EXAMINE CHAR
  1020
                   JSR OSBYTE
STX T1
                                             ALREADY HERE
  1030
  1040
  1959
                                             SEE IF IT IS
PART OF TOP
WALL, IF SO
GO TO "LIC"
                   LDA T1
CMP #112
  1060
  1070
  1080
                   BNE SKP1
  1090
                          LID
  1199
  1110.SKP1 CMP #181
                                             PART OF LEFT
                   BNE SKP2
  1120
  1130
  1140
 1150.SKP2 CMP #234
1160 BNE SKP3
170 JMP SIDE
                                              AND SAME FOR
                                             RIGHT WALL ..
1170
 1180
1190.SKP3 CMP #47
1900 BNE SKK2
                                             VIF IT WAS
                    JMP BAT
                                             GO TO "BAT
  1220
                                 ALSO TEST FOR
  1230.SKK2 CMP #42
       BNE SKK1
                   JMP LBAT
                                             SIDE OF BAT
 1250
 -1270. SKK1 CMP #37
                                             AND OTHER ONE
 1288
                   BNE SKK3
  1388
 1310.SKK3 LDA BY
1320 CMP #21
1330 BNE SKP4
                                              IF BALL
                                             GONE OUT
                                             RETURN TO
BASIC.
  1359
 1360.SKP4 LDR T1
1370 CMP #124
                                            SEE IF BALL
 1370
```

```
BNE SKPS
1380
                                    BRICK, IF SO
 390
               JMP BRICK
                                    GOTO"BRICK"
1400
1410, SKP5 LDA
                     #31
                                     MOVE TO TAB
                    OSWRCH
LX
OSWRCH
                                    POS. OF LAST
POS. OF BALL
AND RUB IT
              JSR
LDA
1430
1440
               ISP
               LDA LY
JSR OSWRCH
              LDA
                                     OUT
1460
              LDA #ASC" '
JSR OSWRCH
1480
1490
1500
1510
              LDR PX
AND #1
                                    FIND PIXEL
               STA DX
                                    OF BALL.
              CLC: ADC DY
CLC: ADC DY
TAX
                                    VUSE LOOK-UP
1540
1550
                                    TABLE TO
DECIDE WHICH
              LDR.DOT,X
STR T2
 579
589
                                    GRAPHICS CHR
                                    IS REQUIRED.
 590
1600
              LDR #31
JSR OSWRCH
                                    DO A TAB, AND
1620
1630
              LDA BX
JSR OSWRCH
                                    GRAPHICS
CHARACTER
1640
              LDB BY
                                     THAT WAS
                    OSWRCH
T2
                                    WORKED OUT
TO REPRISENT
 650
              JSR
LDA
1660
1670
1680
               JSR OSWRCH
                                    THE BALL.
              LDA BX:STA LX SET NEW LAST
LDA BY:STA LY COORDINATES.
1690
1710
1710
1720 THE NEXT SECTION IS RESPONSIBLE
1730 FOR SCANNING THE KEYBOARD AND
1740 MOVING BAT ACCORDINGLY.
1750
1760.MBAT LDA #129
                                  TEST Z,X KEYS
USING THE OS
OSBYTE 129
EQUIVALENT OF
1770
              LDY #8FF
LDX #8BD
JSR OSBYTE
1790
800
              TYA:BMI XGOT
LDA #129
LDY #%FF
                                  \INKEY(-67)
\OR INKEY(-98)
                                   AND BRANCH TO
 828
                                   CORRESPONDING
               JSR DSBYTE
848
1850
                                   ROUTINES
              BMI ZGOT
                                  YZ,X PRESSED
1870
1880.KBD2 JMP BALL RETURN TO START.
1890
900.XGOT LDA BY:STA TI FIND VALUE
910 JMP BT1 TO BE ADDE
                                    TO BE ADDED
1920. ZGOT LDA #0 SEC
              SBC BV
STR T1
                                    AND STORE
1940
1950
1960.BT1
                                    MOVE TO TAB
              JSR OSWRCH
LDR BP
JSR OSWRCH
                                    POS. OF START
1970
1988
2000
              LDR #21
               JSR OSWRCH
2020
                                    NEXT FEW
              LDY BL
              LDA #ASC" "
JSR OSWRCH
DEY BNE BT2
                                    LINES DEALS
2040
                                    WITH RUBBING OUT OLD BAT.
2058.BT2
2070
              LDA DB
```

```
(continued from page 81)
Perform Tab
Test z and x keys
on keyboard
                        1760-1790 OSBYTE(129)
Printing spaces to
                       2030-2090 OSWRCH
rub out bat
They are repeated at several different places in
the program. The assembly code is fully
commented so it should be possible to develop
the game further if required.
              LDA #ASC" ": JSR OSWRCH
  2090
  2100
  2110.BT3
              LDA
                                 NEXT SECTION
              CLC:ADC T1
STA T2
AND #1:STA T3
LDA T2:LSR A
STA T4
                                WORKS OUT
POSITIONAL
DETAILS OF
NEW BAT AND
  2149
                                STORES THEM.
```

(continued on page 85)

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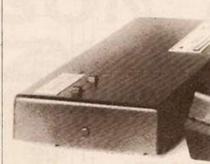
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or ZX Spectrum.



(continued)	from	page 83)	
2980 2990		#1	X TINU HTIW
2990	STY	XV	VELOCITY IN
3000	JMP	82	MAGNITUDE
3010.B1	LDY	#255	
3020	STY	XV	
3030.B2	LDR	#10	
3848		LD1	
3050	- 700000		
3060.RBRT	LDR	#2	VIF BALL HIT
3060.RBAT 3070	STR	XV	LEDGE OF BAT
3080 3090.LBAT	IMP	B2	DIFFERENT
3090 L BBT	LDB	#254	BOUNCING
3100	STR	XV	NOCCURS
3110	.IMP	BS XV	
3120	~		
A STATE OF THE PARTY OF THE PAR	VEXT	SECTION	DEALS WITH THE
3140 BALL			
3150			, Dicker
SIGO PRICE	CID	9 40	SHOPE OUT THE
2170	CEC	1 110	WORK OUT THE
3170	ODC	BY	AND PUT IT
3190	CLC	01	IN TI.
3200	OUC	WS	VIN 11.
3210	STA		
3220	SIM	11	
	100	BX	NOW WORK OUT
3240	SEL	SBU #2	THE START
			NPOS. OF BRICK
		ADC #2	
3270	STA	12	\ =T2
3280			
3290	LDR	#31	DO A TAB TO
3300	JSR	OSWRCH	THEBEGINNING
	LDR		NOF THE BRICK
		OSWRCH	
Control of the Contro	LDA		
3340	JSR	OSWRCH	
3350			
3360			NOW BLANK OUT
	JSR	OSWRCH	RRICK
3380		OSWRCH	
3390	JSR	OSWRCH	
3499	JSR	OSWRCH	
3410			
3420	LDA	T1	WORK OUT
	TAX		PITCH OFBEEP

N. III.A.	TO STATE OF THE PARTY OF THE PA	
3448	ASL A	
3450	ASL A	
3460	ASL A	
3478	ASL A	
3480	STR PITCH	
3498		
3500	TXA	INCREMENT
3519	CLC: ADC S%	SCORE AS PER
3520	STR S%	ROW HIT.
3538	LDR #0	NOTE-SCORE
3540	ADC 5%+1	\IS R 2-BYTE
3550	STR 5%+1	QUANTITY
3560	JSR PRMS	THIS ROUTINE CHECKS HOW HIGH THE SCORE IS AND
The second secon	THE DIFFICULTY	
3570		
3580	LDB THRU	NEGATE Y-CMP
3598	BMI IBC	OF VELOCITY
3698	LDR #0	VIE NOT
3610	SEC SBC YV	SREAKTHROUGH
3629	STR YV	SONE IN THE COURT OF THE PERSON OF THE PERSO
3630		AND THE RESIDENCE OF THE PROPERTY OF THE PERSON OF THE PER
The second second	BC LDR BC	Statement Statement and September 1981 and the Statement of the Statement
3650	CLC: ADC #1	INCREMENT
3660	STR BC	BRICK COUNT
3670	0111 00	TORICK COOM
3688	I DB #0:TBY:	TAX:RTS RETURN TO BASIC WITH ALL REGISTERS ZERO'D
3690	2011 110 1111	TOWN TO SHE TOWN TO SHOTE WITH HELL RESISTERS SERU D
	THE EDITIONING SI	UBROUTINE USES A LOOK UP TABLE CALLED "LEVEL" TO DECIDE
ON THE	SPEED OF THE CO	ME FOR ANY PARTICULAR SCORE LESS THAN 1024
3710 PS	PMS I DV SV41	GET SCOREHIGH
3720	LDY S%	GET SCORE LOW
3730	TXA:ROR A	JET SOOKE LOW
3740	TBX: TYB	and the second of the State of the second of
3750	ROR A TAY T	20
3760	ROR A: TAX: T	
3778	ROR A: TAY	
3780		LSR A:LSR A
3790		EL,X:STA SPEED:RTS
NEWSTRANSPORTSON AND A	LAY PHA TYR PHE	
3810	LDX SPEED	TOTAL COLUMN TO THE PARTY OF TH
3820.D2		
3830.D1		
3840	DEX BNE D2	
3850	A STATE OF THE PARTY OF THE PAR	R:TAY:PLA:RTS
38697	PEU- IDV- PE	THE PROPERTY OF THE PROPERTY O
Company of the last of the las	KT PASS%	
3880END		
SOSSEND	1100	
	A STATE OF THE PARTY OF THE PAR	

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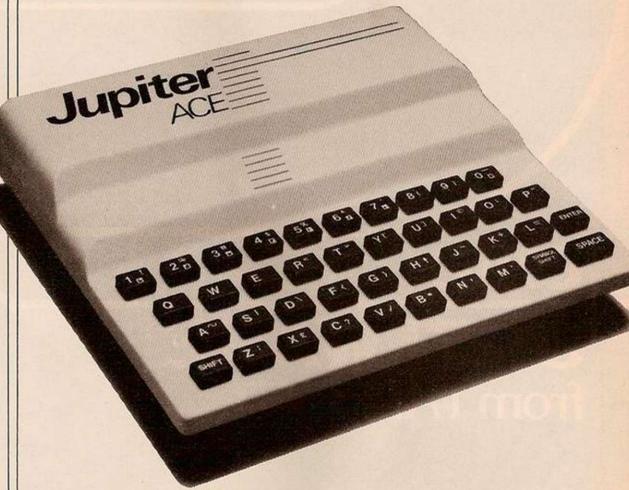
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FILL			
BACKGR (ASCII CODE-		4D	
RST 24	223		
LD HL (9216) LD B (23)	33	23	36
	197	32	
LD A (HL)	126		
CP (32) JRNZ (+2)	254 32	32	
	123		
INC HL	35		
DJNZ (-10) POP BC	16 193	246	
DJNZ (-16) JP (IY)	16 253		
FILL			
FOREGR		4D	
(ASCII CODE-	223		A
LD HL (9216)		23	36
	197		
LD B (32)	126	32	
	254	32	
LDAE	123		
INC HL A	119 35		
DJNZ (-10) POP BC	16 193	246	
DJNZ (-16) JP (IY)	16	240 233	
		200	
REPLACE			
(ASCII CODE :	SEARC	H	,
RST 24	223	CE-	'
LD C E RST 24	75 223		
		0	36
LD HL (9216) LD B (23) PUSH BC	197	23	
	126	32	
CP E JRNZ (+2)	187	2	
LDAC	121		
INC HL	119		
DUNZ (-9) POP BC	16	247	
DUNZ (-15) JP (IY)	16	241	
	233	233	
INVERT			
LD HL (9216)		0	
LD B (23) PUSH BC	197	23	
LD B (32)	126	32	
ADD A (128)	198	128	
INC HL	119 35		
DUNZ (-7) POP BC	16 193	249	
DJNZ (-13) JP (IY)	16	243 233	
Dr (11)	253	233	



Forth is fast, but a little bit of machine code will take you through the light barrier. Simon Cross shows you how to accelerate your Jupiter Ace with this handy kit of 10 screen-handling routines for those situations where Forth is still not quite fast enough and the ultimate speed of machine code is what you require.

THE JUPITER ACE offers an alternative for those who wish to write fast arcade games but cannot face the sometimes daunting challenge presented by machine code. The speed advantage that Forth has over Basic enables the games programmer to write "spaceinvader" type programs without reaching for an assembler. However, there are still some situations where Forth is not quite fast enough and the ultimate speed of machine code is

One such situation is writing screenhandling routines such as scrolling. Try this Forth word which fills the screen with a character specified by an ASCII code taken from the top of the stack:

FILL 9952 9216 DO

DUP I CI LOOP DROP

Execute this word by typing an ASCII code followed by "fill", for example "42 fill" will produce a screenful of stars. It can be seen that although the screen is filled quite rapidly, the process of printing is visible passing in a wave from the top to the bottom of the screen. When this routine is written in machine code the process appears to be instantaneous; this is useful for creating explosion effects and the like. The difference in speed between Forth and machine code becomes more marked with more complex routines such as scrolling.

Even when routines have to be written in machine code the Forth environment still has (continued on page 89)



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Tansoft is the software division of Tangerine Computers. (continued from page 87)

some advantages. The routine can initially be written in Forth to test its function in the context of the complete program, particularly its effects on the stack. If the routine works it can be translated into machine code without any alterations to the rest of the program. The routine is called by its name which is more convenient than Rand Usr followed by the address, the technique some Basics use. The main advantage is that since Forth words can be moved around the dictionary by Redefine and Load the machine code must be relocatable.

This article describes 10 screen-handling words written in machine code for the Jupiter Ace. Any combination of them may be included in ordinary Forth programs where speed is important. No knowledge of machine code is required to use them since once they have been entered they act like any other words in the Forth dictionary. The simplest way to enter the code is by using the defining word "Code" described on page 147 of the Jupiter Ace manual:

DEFINER CODE DOES> CALL

The machine code is entered by typing Code then the name of the word followed by the decimal code, each byte being separated by C,. For example the Scrollup routine would be entered by typing:

CODE SCROLLUP 33 C, 32 C, 36 C, 17 C, 0 C, etc.

On pressing Enter the whole typed section will be copied to the upper screen and OK will appear after it. The word can then be executed by typing its name, for example:

SCROLLUP

Code is not a very user-friendly word but, since it is not possible to delete it from the dictionary when the code has been entered, it is important that it should not take up much memory space.

The 10 words will fit into the unexpanded 3K Jupiter Ace, but this does not leave much memory space in which to write programs to utilise the routines. It is better to only enter the words necessary for a specific program.

Here is a description of the individual words: Scrollup scrolls the entire screen one line up and blanks the bottom line; Scrolldown scrolls the entire screen one line down and blanks the top line; Scrollright scrolls the entire screen one column to the right and blanks the left-hand column; and Scrollleft scrolls the entire screen one column to the left and blanks the right-hand column.

Fillscreen fills the screen with a character specified by an ASCII code which should be put on the stack before the word is executed. Fillscreen uses the RST 24 routine in the ROM which takes off the top of the Forth stack and puts it in the DE register pair. Fill-foreground fills all the non-blank areas of the screen with a character specified by an ASCII code on the stack. Fillbackground fills all the blank areas of the screen with a character specified by an ASCII code on the stack.

Search&replace takes two numbers from the stack. The first number is the ASCII code of the character to be searched for on the screen. Any occurrence of this character is replaced by

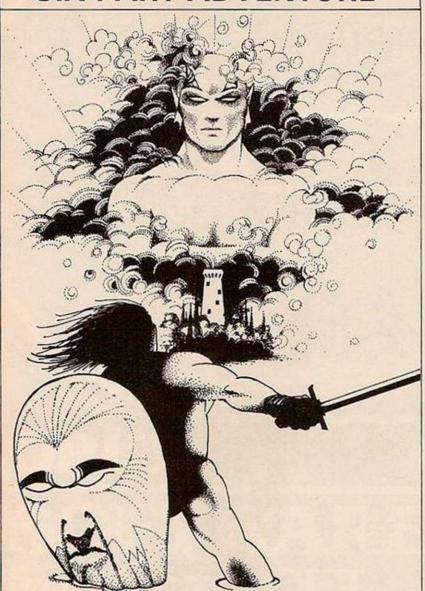
another character whose ASCII code is given by the second number. This word is useful to selectively "flash" parts of the screen for explosions or countdowns.

Invert turns all the characters on the screen into their inverse forms. It is useful for explosion effects when used in loops such as this: BANG 21 1 DO INVERT I 10 * 60 BEEP LOOP

Border prints a border round the edge of the screen using the character specified by an ASCII code on the stack.

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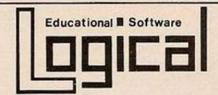
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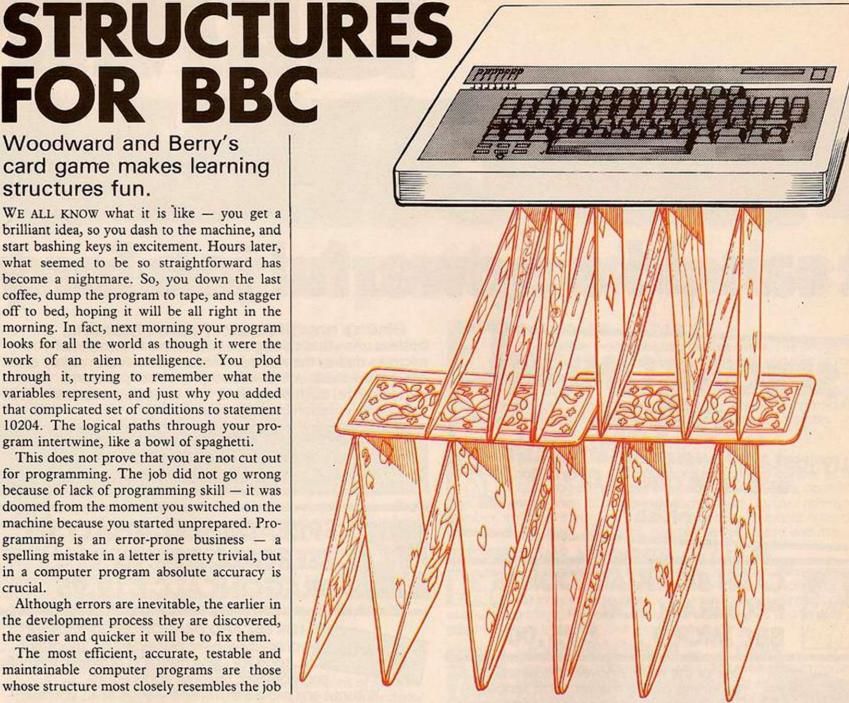
structures fun.

WE ALL KNOW what it is like - you get a brilliant idea, so you dash to the machine, and start bashing keys in excitement. Hours later, what seemed to be so straightforward has become a nightmare. So, you down the last coffee, dump the program to tape, and stagger off to bed, hoping it will be all right in the morning. In fact, next morning your program looks for all the world as though it were the work of an alien intelligence. You plod through it, trying to remember what the variables represent, and just why you added that complicated set of conditions to statement 10204. The logical paths through your program intertwine, like a bowl of spaghetti.

This does not prove that you are not cut out for programming. The job did not go wrong because of lack of programming skill - it was doomed from the moment you switched on the machine because you started unprepared. Programming is an error-prone business - a spelling mistake in a letter is pretty trivial, but in a computer program absolute accuracy is crucial.

Although errors are inevitable, the earlier in the development process they are discovered, the easier and quicker it will be to fix them.

The most efficient, accurate, testable and maintainable computer programs are those whose structure most closely resembles the job



that the program has been designed to do.

Writing programs that work, and completing them before you get fed up with them, is fun. Unless we pay due regard to the above maxim, that fun will be replaced by misery and frustration. So, what we want is a methodology for approaching this programming task - and structured programming is just that.

Let's go back to that wonderful inspirational moment when the idea comes. Instead of rushing to your machine and spoiling it all, grab a piece of paper and write down in plain language what the objective of the program is. The original statement is usually termed "the problem". Next, try to break down the main problem into subordinate problems, the essential things your program has to achieve to solve the problem. You can continue in this way, building a hierarhy of problems at increasing levels of detail.

So far, this may all sound pretty trite where is the methodology? There are many different schemes to be found in books and in use, but they all attempt to show the same things: a hierarchy of problems; decisions or branches; loops or iterations.

From now on, we will try to explain the process by developing a program to play the card game of Pelmanism. If you are not familiar with the game, do not worry - all will be revealed as we proceed. You will acquire the necessary knowledge as your analysis gets deeper into the problem. Approaching problem analysis in this layered way is called topdown design.

Figure 1 shows a possible first-level breakdown of the Pelmanism problem. The main problem, "Play Pelmanism", is found to consist of two sub-problems, "Set up game" and "Play Game". The diagram is read top-tobottom, left to right, so the diagram tells you that you have to set up the game before you can play it.

We discover that set-up consists of getting a pack of playing cards, shuffling them, and then laying them all, face down, in random places on the table. Figure 2 shows how these sequential tasks are added to the diagram.

That is probably as far as we need to go at present in the set-up problem area, so let us now analyse the play-game problem. We discover the rules are that two players take turns. At each turn, the player turns up two cards. If they are of the same value, for example two kings, the player gets a point, and the cards are removed.

If they are not of the same value, they are replaced in their original positions, face down. So, we have a loop - rotate around the players in turn - and a decision - if the cards match, do one thing, otherwise do something else. Figure 3 shows how the play-game problem can be broken down to incorporate these tasks, and includes the loop and the decision. The loops are represented by curved arrows. The decision is represented by a little diamond.

It should be apparent that what happens on Player B's turn is essentially the same as happens for Player A. We have revealed a whole chunk of problem which might have (continued on page 99)

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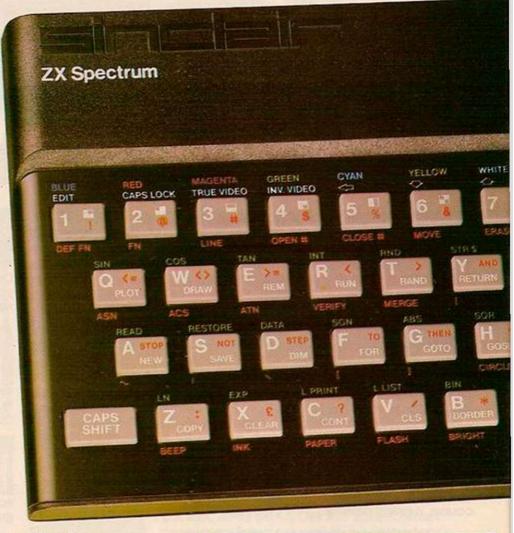
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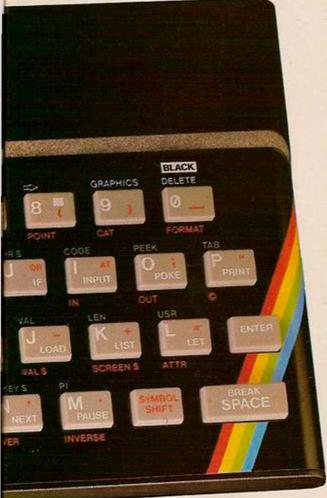
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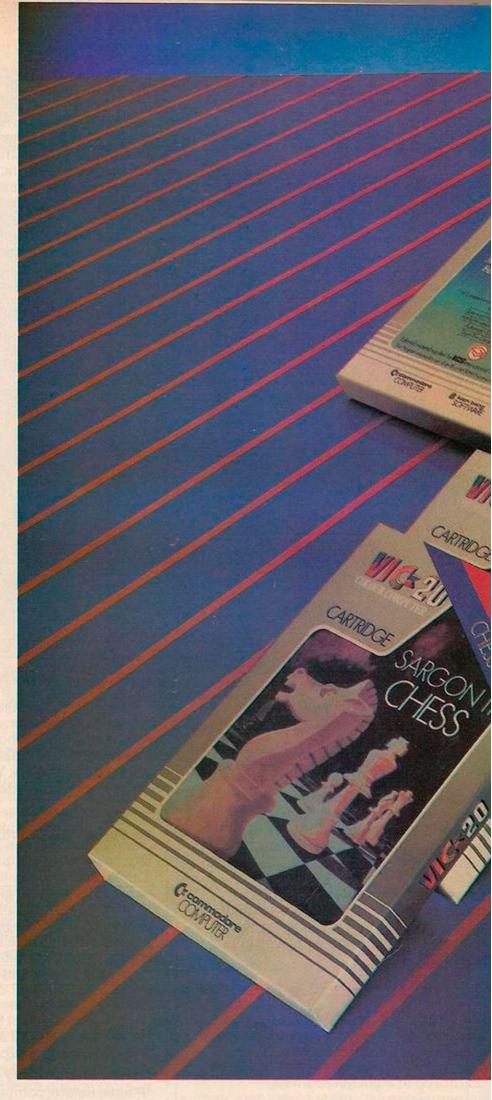
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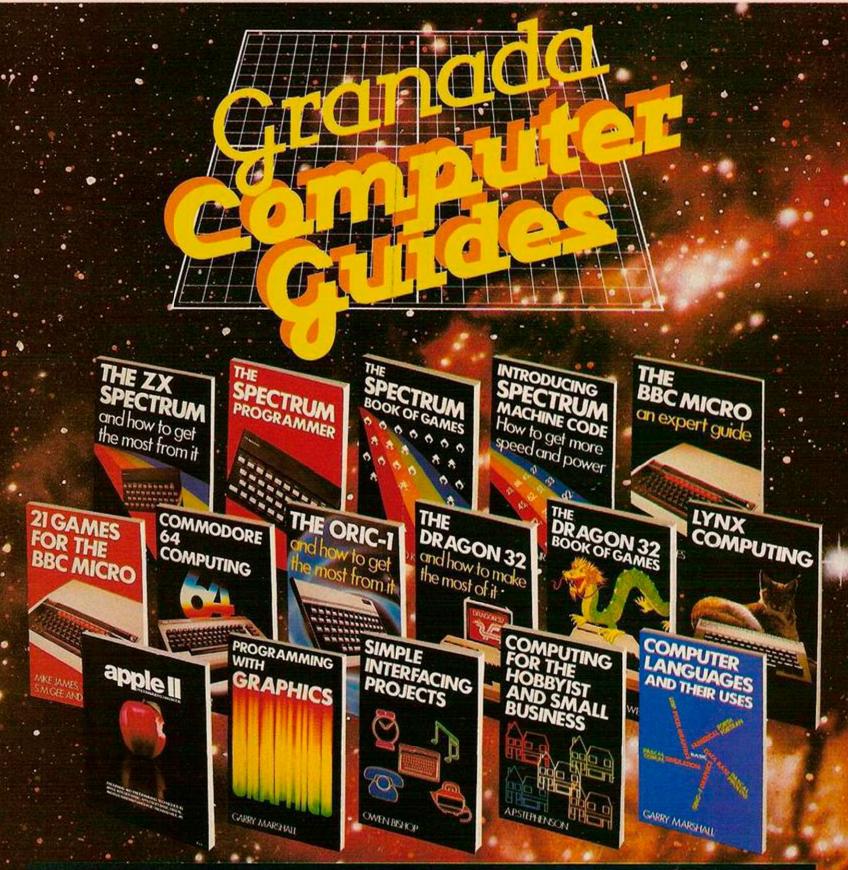


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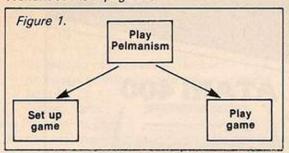
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(continued from page 91)



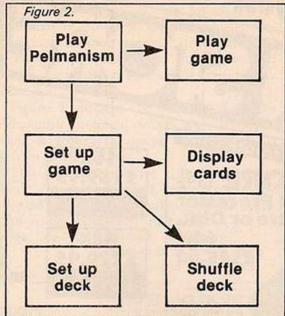
resulted in duplicate code, had we started to program too early. Of course, most of you would have spotted such duplication straight away, but the principle is valid. If it occurred at a lower level, you might not have recognised it. There is no need to duplicate parts of the diagram, so we simply put the note "as for player A" under "Player B's turn" - see Figure 3.

Just identifying a loop is hardly sufficient we have to say what stops it. Once again, this is expressed in plain words - no flags to be used at this stage, please! Therefore, in Figure 3, we have added legends like "Repeat until all the cards have been paired" to the arrows representing the loops. Similarly, we have defined the decisions, but, because of lack of space, these definitions appear as footnotes. The other addition in Figure 3 is the box "Print Results". We have decided that, at the end of the game, we should display the scores.

We hope you can see already that this is an easy-to-understand representation of the game problem. You will notice that it describes the Problem, and not the Solution - so it is just as appropriate as a description of the game as played with cards as of its simulation on the computer. Therefore, when you do eventually code it, your program will represent reality, will correspond closely in structure to your design solution, and you will be able to enhance it later, if you wish.

Notice also that the structure diagram is universal, and is not tied to any particular programming language or dialect, or to any particular computer. For example, we have not said whether the loops will be implemented as "For-Next", "Repeat-Until" or "Do-While".

Now, although we have some way to go to fully define the problem, at the level of detail required for a complete solution, we could at this stage start to write the program. The



approach is that it does make it possible to

40 PROCB (or GOSUB 2010)

UNTIL FLAG = 1

70 END

1000 DEF PROCA (not required for GOSUB)

1010 PRINT "PROCA HAS BEEN EXECUTED"

1999 ENDPROC (or RETURN)

2000 DEF PROCB (not required for GOSUB)

2010 PRINT "PROCB HAS BEEN EXECUTED"

3000 DEF PROCC (not required for GOSUB)

3010 PRINT "PROCC HAS BEEN EXECUTED"

Clearly, the program will get stuck in the loop which calls procedure B for ever and a day. Of

essence of the structured "top-down"

develop programs in a modular way. Let us take the low-level boxes, such as "Pick a card". They are still black boxes at this stage, and can be coded as dummy procedures or sub-routines. Such dummies are known in the trade as "stubs". You can then run and test your skeleton program for basic errors. If you include temporary Print statements within your "stubs", you can prove to yourself that the procedures or sub-routines are being entered and left in the correct sequence. Note that you may have to force the program to proceed from one state to another by other temporary statements. Take the following example: 10 PROCA (or GOSUB 1010)

20 FLAG = 0

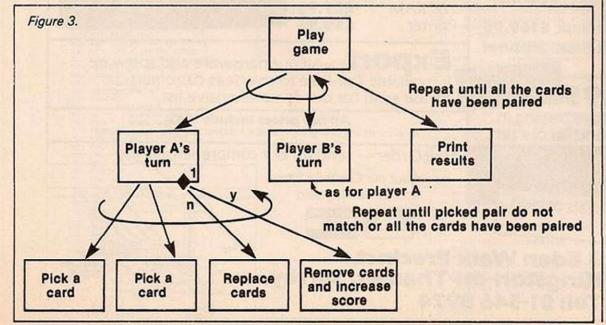
30 REPEAT

60 PROCC (or GOSUB 3010)

2999 ENDPROC (or RETURN)

3999 END PROC (or RETURN)

course, the real code to be placed in procedure



B will do something which results in Flag being set to "1", but you have not written this yet. So, once you have tested the program as above, simply insert a new statement 2020, setting Flag equal to "1". This will force the program to leave the loop and execute the later code.

To return to the Pelmanism problem, we are approaching an adequate definition, but need to be more precise. For example, the box "Pick a card" needs to be expanded as in figure 4.

Let us now recap on what we have been doing. First, we defined our problem at the highest meaningful level, then at the next level down. We were then able to code our program in skeleton form. As further understanding came, we could expand our structured design downwards into increasing levels of detail, and, at each level, could insert code into "black boxes". This process can be summarised as:

DEFINE OBJECTIVE DEFINE PROBLEM ELEMENTS AT CURRENT LEVEL CODE SKELETON SOLUTION IF PROGRAM COMPLETE, STOP **OTHERWISE**

The more astute of you will be a little cynical about the glib way we suggest you flip from adding a box to the diagram to actually coding it - and quite right, too. The coded solution to one box may, of course, be far from simple. It may require some thought as to how you can program it. Again, we urge you not to try to develop this code at the keyboard. You will find your time is far more productive if you try to sketch out the required code beforehand, using some kind of shorthand notation. This is where we can learn from the experience of professionals, and introduce the concept of "pseudo-code".

Various academics have written doubtless worthy tomes on language systems for pseudocode. Some advocate a free-form representation, similar to Basic, whilst others prefer to have you fill in complicated-looking forms. Our advice is to forget all that, unless you are intent on immersing your hobby in a bureaucracy. You should develop your own shorthand notation - after all, you are the only person who will have to understand it. It is different for professionals in a big department, where other programmers have to pick up the documentation and work from it.

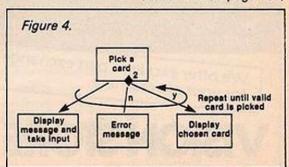
What does pseudo-code look like? It is somewhere between a precise form of English and the program code itself. Its syntax is loose, but its format should be consistent and clear. The pseudo code for the box "Set-up game" in the Pelmanism problem could be:

Proc set up game

- Set up deck

Set up a string of card values

(continued on page 101)



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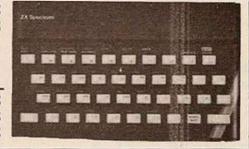
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(continued from page 99)

Establish address of string
 Shuffle cards

- For I = 1 to 20

- Select two card values at random

- Exchange position of card values in string

- Next I

Display cards

End Proc set-up game

You can see that pseudo-code enables you to resolve most of the problems due to logical flow, off-line. Nothing you do here can wreck the work you have already coded. Once you have fully desk-checked your pseudo-code, it is a straightforward matter to put it into the pedantic language your computer expects.

We know from experience that this

methodology works — not just for us, but for thousands of people in the professional programming business as well. It produces the correct results quicker, and that, as we said earlier, does make programming considerably more fun.

Figure 5 contains the full listing of the Pelmanism program, which was developed using a structured design approach. It is written in BBC Basic.

This particular solution uses the Teletext Mode (7), but it could, with benefit, be adapted to use high-resolution graphics mode, with proper pictures of the cards.

Lines 40-110 Main body of program

Call routines to Set-up game Play game and Print results Lines 120-470 Procedure to set up game
Card backs are represented by
graphics symbols
Lines 480-620 Play Game
Uses keys to move cursor,

and select card.
I-up; M-down; J-left; K-right;
R-reveal.

Lines 630-780 Player's turn Lines 790-870 Pair match Lines 880-970 No match

Lines 990-1130 Scan keyboard for input

Lines 1140-1370 Move cursor Lines 1380-1500 Turns over card

Lines 1510-1680 Calculate which card to turn over

Lines 1690-1800 Input players' names Lines 1910-1910 Prints final scores

```
(Pelmanism program)
       10 REM
20 REM
30 REM
40 MODE 7
50 CLS
60 PROCSETUP
ENDPROC
DEF PROCTURN(PLYS)
REM + PLAYERS TURN +
REM
                   REPAT

REPEAT

PRINTTAB(0,21);"PICK YOUR FIRST CARD ";PLY*;SPC(10)

PROCMOVE

CD1=CARD?REV

AD1=ADDRESS

PRINTTAB(0,21);"PICK YOUR SECOND CARD ";PLY*;SPC(10)

PROCMOVE

CD2=CARD?REV

AD2=ADDRESS

JF CD1=CD2 THEN PROCPOINT ELSE PROCFINISH

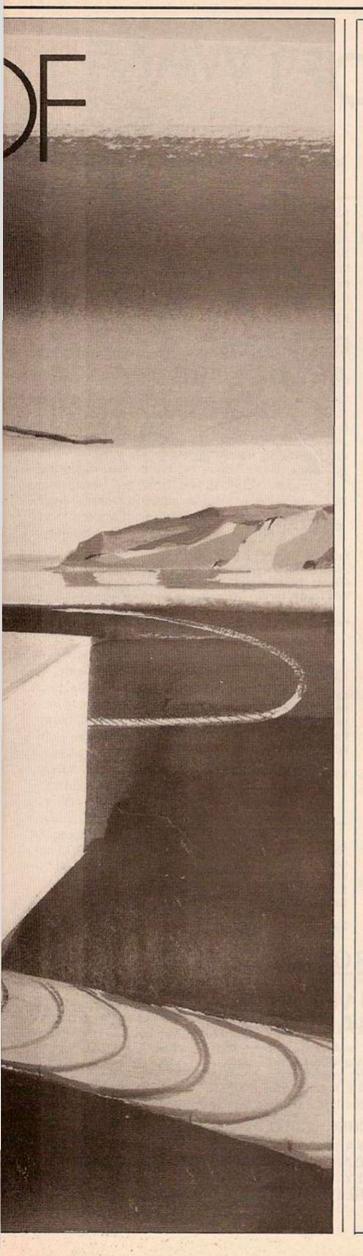
UNTIL CD1 <> CD2 OR SCORE+SCOREA+SCOREB > 25

ENDPROC
      1940 CLS
1970 PRINTTAB(11,3);CHR*(135);CHR*(157);CHR*(129);CHR*(141);"PELMANISM ";CHR*(156)
1980 PRINTTAB(11,4);CHR*(135);CHR*(157);CHR*(129);CHR*(141);"PELMANISM ";CHR*(156)
1990 PRINTTAB(0,10);
2000 IMPUTDD YOU REQUIRE INSTRUCTIONS ", ANSWER*
2010 IF MIDB(ANSWER*,1,1) <> "Y" THEN ENDPROC
2020 PRINTTAB(0,8);" PELMANISM is a simple card game for":" two players. The cards are placed face":" down, the object is to turn up pairs"
2030 PRINTTAB(0,14);CHR*(130); "Each player takes it in turn to try";CHR*(130); "and pick two cards which match, if they";CHR*(130);"are a pair then they are removd from"
2040 PRINTCHR*(130); "the pack and the successful player gets";CHR*(130); "another turn."';CHR*(129)*The winner is the player who has turned";CHR*(129); "over the agreatest number of pairs at"
2050 PRINTCHR*(129)*The end."
2060 PRINTCHR*(129)*The end."
2070 As-GETs
2080 CLS
2090 PRINTTAB(11,3);CHR*(135);CHR*(157);CHR*(130);CHR*(141);" CONTROLS ";CHR*(155);CHR*(157);CHR*(130);CHR*(141);" CONTROLS ";CHR*(157);CHR*(130);CHR*(141);" CONTROLS ";CHR*(157);CHR*(130);CHR*(141);" CONTROLS ";CHR*(157);CHR*(157);CHR*(150);CHR*(141);" CONTROLS ";CHR*(157);CHR*(157);CHR*(150);CHR*(141);" CONTROLS ";CHR*(157);CHR*(157);CHR*(150);CHR*(141);" CONTROLS ";CHR*(157);CHR*(157);CHR*(150);CHR*(141);" CONTROLS ";CHR*(157);CHR*(157);CHR*(150);CHR*(141);" CONTROLS ";CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CHR*(157);CH
     *(156)
2100 PRINTTAB(11,4);CHR*(135);CHR*(157);CHR*(130);CHR*(141);" CONTROLS ";CHR*(156)
                                                                                                                                                                                                                                                                                                                                       $(156)
2110 PRINTTAB(0,10);CHR$(129);" I ";CHR$(130);CHR$(141);" CONTRO
2110 PRINTTAB(0,10);CHR$(129);" I ";CHR$(135);"- TO GO UP"
2120 PRINTTAB(0,12);CHR$(129);" M ";CHR$(135);"- TO GO DOWN"
2130 PRINTTAB(0,14);CHR$(129);" J ";CHR$(135);"- TO GO LEFT"
2140 PRINTTAB(0,14);CHR$(129);" R ";CHR$(135);"- TO GO LEFT"
2150 PRINTTAB(0,18);CHR$(129);" R ";CHR$(135);"- TO REVEAL THE CARD"
2160 PRINTTAB(10,24);CHR$(131);CHR$(136);"Press any key to continue"
2170 AS-GET$
2180 EMDPROC
   1050 REPEAT
1050 INS=INKEYS(0)
1070 IF INS="I" THEN PROCUP
1080 IF INS="J" THEN PROCLEFT
1090 IF INS="K" THEN PROCRIGHT
1100 IF INS="K" THEN PROCROWN
1110 IF INS="R" THEN PROCECVEAL
1120 UNTIL INS="R" AND FLAG=1
1120 ENDPROC
1140 DEF PROCUP
```



(continued on page 105)

modes.



16K mother program.

10

20 REM for 16k Spectrum 30 REM ON.DORE 35 CLEAR 32329: LET c=0 40 FOR 1=32330 TO 1e9: READ IF a <256 THEN LET c=c+a: POK POKE ABS a: NEXT i 70 IF a <>c THEN PRINT "ERROR I N PROGRAM": STOP 100 REM ON/OFF routines 110 DATA 62,40,237,71,237,94,20 ,0,0,0,62,62,237,66,237,71,201, 2 120 REM SERVICE ROUTINE 130 DATA 255,243,197,213,229,24 5,1,254,127,237,120,254,252,40,9 ,205,144,126,241,225,209,193,251 ,201,62,56,50,141,92,205,107,13, 1,254,127,237,120,254,252,40,247 ,251,207,20,0,0,0,0,0,0,0,0 140 REM User routine (here RET) 150 DATA 201,9306 150 DATA 201,9306

REM Spectrum Interupts

16K mother program Z-80 code.

ON ROUTINE	
ld 3,40 ld i,a im 2 ret	62 40 237 71 237 94 281
ld i,a	237 71
10 2	237 94
181	581
OFF ROUTINE	
ld a,62	62 62
im 1	237 86
10 1,8	62 62 237 86 237 71 201
CEDMENT COMME	561
SERVICE RUDITINE	
131 55	255
Diet to	442
push de	213
Push bi	229
push af	245
ld bc,32766	1 254 127
in a, (c)	237 120
CP 252	254 252
JC Z,+9	48 9
carr SEARR	205 107 13
POP A	241
PAD de	280
P02 bc	193
Ei	251
ret	261
ld a,56	52 55
19 (53653) (5	26 ItT 55
call cls (3435)	502 101 13
10 00,02/00	201 52 55 50 141 92 205 107 13 1 254 127
rp 050	024 020 ED/ TED
ir z 9	52 55 50 141 92 205 107 13 1 254 127 237 120 254 252 46 247
ei	251
rst 8 (reports)	207
im t ROUTINE ROUTINE	2437 2437 2437 2437 2437 2437 2437 2437

Figure 5 This generates a moving landscape at the bottom of the screen which can be used in one of your own games. The speed at which the ground moves can be changed by Poking 23681 which should be followed by Poke 23672,0. This program should be saved before being run.

140 REM moving land data 150 DATA 58,120,92,33,129,92,70 ,184,216,62,0,50,120,92,33,96,90 ,6,160,126,254,0,32,7,54,56,43,5 140 > REM

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XENO II

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All M/C version of Centipede. Homing spiders, mushroom laying fleas and multidirection travel makes this game fast and furious, with 10 skill levels.

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PHARAOH'S TOMB

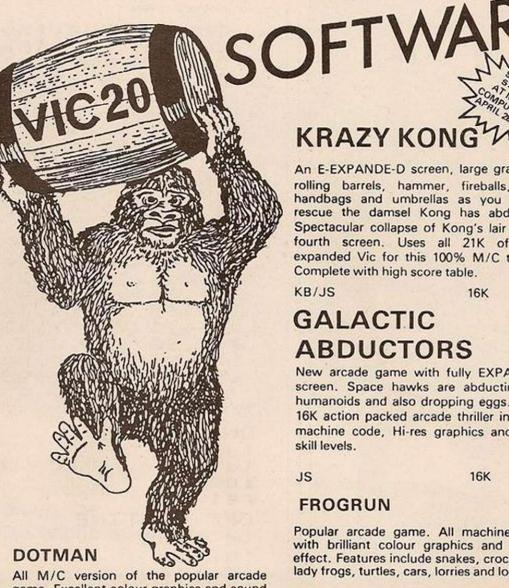
Once you enter, the only way out is with the aid of a key which unlocks the mystery of the Pharao's tomb. Beware of the mantraps the ancient Egyptians so painstakingly built. One false move and you will meet the same fate as befell other tomb robbers over thousands of years. A multiscreen big graphical adventure with M/C movements.

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(continued from page 102)

thinks it sees FFh or 255 decimal. Thus we need only change that I register so that the address

1*256 + 255

and the following one point to our user routine. However, the I register cannot be moved so that

1*256

is in RAM without causing screen interference.

Therefore we must find our vector address somewhere in ROM. A quick search finds suitable vectors for both 16K and 48K machines:

1=40

will produce a jump to 32348 for 16K machines,

1=9

will produce a jump to 65129 for 48K machines. In order to see what can be done with these interrupts first type in the mother program for your particular machine which allows all the following programs to be compatible between both machines. After typing in the program, Run it. If after a few seconds, an "Error in program" message appears, then carefully check the Data statements and try again. If "OK" appears then save the program as the checksum does not detect all possible errors. Here are the commands for turning the routine on or off:

> 16K LET a= USR 32330 48K LET a=USR 65180 OFF 16K LET a = USR 32340 48K LET a = USR 65190

Turn the routine on. If the computer crashes, then re-load the program and check it carefully. If "OK" appears on the screen then the routine should be working. The mother program on its own adds one useful feature: the depression of symbol-shift and space together now acts as Break but with these added advantages. The new Break works in machine-code loops, it clears the screen and returns the colours to the normal black on white. The use of this break when not running a program causes a buzz with Colour Reset and Clear Screen.

To see what the routine can do, turn it off and add the lines in figure 1 erasing the original lines of the same line number. Make sure you have turned the routine off and Run the new program. Turn the routine back on and you will be greeted by a pulsating border display and a clicking sound which continues while your own programs are running.

You might like to try loading a Basic program off a cassette. The border display will stop during the load, as it will during Beep, for the computer disables the interrupts because timing is important. The border will start pulsating again as soon as the program has loaded. This program achieves its effect by outputting the contents of the frame counter to the port which controls the border 50 times a second.

The other five examples can be entered in the same way but remember to take great care that the old routine is turned off before running the mother program to enter the new routine.

```
4,0.35,0.35,16,241,42,121,92,35,34,121,92,36,1,70,56,176,92,254,1,40,23,58,177,92,203,64,40,4,60,50,177,92,241,22,29,62,1,50,176,92,24,22,0,56,177,92,203,64,4,40,4,60,160,237,62,24,22,0,56,177,92,203,64,4,4,60,160,237,62,6,62,2,50,176,92,0,58,177,92,71,17,32,0,33,255,90,54,0,183,237,82,16,249,201,19586,237,82,16,249,201,19586,237,82,16,249,201,19586,237,29,2:POKE 23681,1:
 48K Mother program
                                                   Spectrum
for 48k 3
                                                                                                    Interupts
Spectrum
             10
                            REM
           20 REM (or 48k Spectrum
30 REM @N.DORE
35 CLEAR 54911. LET 5=0
40 FOR 1=55129 TO 169: READ a:
F a=256 THEN LET 1=54312: NEXT
```

00 IF a (256 THEN LET c=c+a: PO i,AB5 a+(a (0) *127: NEXT i 70 IF a+96<>c THEN PRINT "ERRO IN PROGRAM": STOP 70 IN

R IN PROGRAM": STOP
100 REM SERVICE ROUTINE
110 DATA 255.243,197.213.229.24
5,1,254,127,237,120,254,252,40,9
,205,144,253,241,225,203,193,251
,201,62,56,50,141,92,205,107,13,
1,254,127,237,120,254,252,40,247
,251,207,20,0,0,0,0,0,0
120 REM ON/OFF routines
130 DATA 62,9,237,71,237,94,201
,0,0,0,62,62,237,86,237,71,201,2 56

140 REM User routine (here RET) 150 DATA 201,9306

Figure 1.

140 REM border display 150 DATA 58,120,92,211,254,201, 10041

Figure 2 This shows you how your Spectrum can generate sounds while you enter or run a program.

140>REM sound 150 DATA 42,120,92,203,61,36,0,41,41,41,41,17,2,0,205,181,3,201,10434

Figure 3 This makes the screen scroll automatically unless the n key is pressed.

140 REM Non-stop scrott 150 DATA 1,254,127,237,120,254, 247,200,52,5,50,140,92,201,11095

Figure 4 This provides an On Error Beep function. It causes the computer to beep when an error occurs until Enter is pressed.

140 REM On error bleep 150 DATA 58,58,92,254,255,200,1 7,150,0,33,100,0,205,181,3,243,2 01,11155

Figure 6 This last routine generates a display of the 24-hour clock at the top right of the screen. The computer will even beep on the hour, all while your own program runs. Save this program before running it.

,16,251,62,127,50,20,08,50,23,0 ,50,29,58,50,31,88,50,26,83,201 0,00,17,128,0,33,0,1,205,181,3 243,201,22150 180 DIH 0 \$ (10): INPUT "Hour";

"Minutes "; a: LET 0 \$ = 1"0" AND L
EN STR\$ h = 1) + 5TR\$ h + "0" + (10) AND L
EN STR\$ h = 1) + 5TR\$ a + "00000";

OR i = 1 TO 10: POKE i + 32533 + (PEEK 23733) 130) * 32512 CODE 0 8 1; - 17

LEN STR\$ h = 10 + 5TR\$ a + 10

SOFTWARE



PAINTER - BBC SPECTRUM, ATOM

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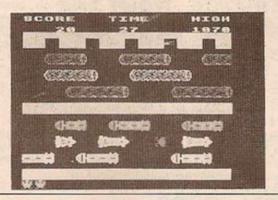
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Mybila the Via 20's feur

While the Vic-20's fourchannel sound facility is one of its most appealing features, do you really know how to make the most of them? John Ransley explores the electronic quartet's potential.

YOUR UNEXPANDED Vic-20 can make you feel like Richard Clayderman, Acker Bilk, John Williams or James Galway. But the big question often asked by Vic owners is, how? After all, my copy of Commodore's introductory manual manages to transpose whole chunks of instructions in that section briefly describing the micro's music-making capabilities — so anyone else attempting to exploit them might be forgiven for taking a powder and going for a long lie-down in a quiet darkened room.

So start again — from here, with some easy routines which I will explain as we go along. Incidentally, if your micro is not a Vic-20, you will find that it is still possible to foster many of these programs, usually by simply substituting for any Poke statements the equivalent Basic command in your micro's dialect, which will probably be something like Sound or Beep.

You can make creative use of at least three of the Vic's four sound generators, individually or collectively, and in several different ways. First, you can use them to play the Vic's keyboard like that of a piano or organ; secondly, the Vic can be a musician, playing itself the music you give it to learn, just as though it was an electronic pianola; thirdly, it can help you compose your own music by combining the two facilities just mentioned; fourth, the Vic can take over the actual composing and produce sonorous fugues or perky rags — and in all the programs that follow, I have incorporated some kind of screen display to help you

understand even better what's going on in the Vic's mind.

The Vic's coundmakers slumber silently in

The Vic's soundmakers slumber silently in four separate Poke locations: 36874, 36875, 36876 and 36877. The first three of these are always used, alone or collectively, to play music. The fourth, 36877, is the white noise generator — all of whose tones sound like nothing so interesting as an untuned radio until you start shaping them.

Of the three music voices, it is convenient to think of 36874 as being the lowest or bass voice; 36875 as the mid-range or tenor voice; and 36876 as the highest, or soprano. Each of these three voices has a library of 126 tones numbered 128 to 254 inclusive, covering some three octaves of the conventional music scale. Poke 36874 drops an octave lower than, and Poke 36876 an octave higher than, Poke 36875. Therefore, you have something like a five-octave range across the three voices.

The only other Poke location you will need is 36878, which is qualified by a number from This command switches on the

0 to 15. This command switches on the volume control and sets the sound level. You may find that the highest setting distorts when played through the speaker of your particular TV or monitor; Poke 36878,10 or Poke 36878,12 should be about right most times.

Type New, hit Return, and enter Program 1. Run this, and you hear each of the 127 tones held in the Vic's bass voice, and see its number displayed on-screen. Everything stops at 254 except the noise. Hit Run, Stop and Restore, then List Program 1. Tone 254 continued because I did not include a line cancelling the volume. So add these lines:

170 POKE 36878,0 180 POKE 36874,0

It is not strictly necessary to include line 180 in this program, but if you do not the old voice will stay live and still be heard behind any other voice Poked.

Each of the three Poke locations is capable of generating 126 notes. Change line 130 in Program 1 to Poke 36875,T and Run; and then to Poke 36876,T and Run to hear the tenor and soprano equivalents respectively. With these, the two or three uppermost tones are at such a high frequency that you may not even be able to hear them.

At this stage, it is important to draw a distinction between tones and notes, because only 25 of the tones in each Poke location are more or less equivalent to the notes ABCDEFG of the conventional musical scale. And to complicate matters, they match up in uneven steps. For example, note E is tone 206, F is 209 and F# is 211. The whole range of 126 available tones thereefore gives you just three octaves, from a low C on tone 131 to a high C on tone 224.

This next simple program proves the Vic's ability to produce an orderly musical scale of eight notes — C major. New the memory and enter Program 2. In this program, lines 110 to 130 set up a store cupboard of tones equivalent to the scale of C major and their names; count up the pairs and you will find they total eight in number. Lines 140 and 160 form a loop that makes line 150 read through each Data pair and store them in memory as matched sets tagged 1 to 8.

At line 170, the Vic is waiting for you to tell it which pair you want brought up front, by touching any one of the keys numbered 1 to 8 on the top row of the keyboard; the second half of line 170 makes the Vic go round in circles until you do so.

Line 180 takes the value of the key you have touched and marries it up with the Data pair tagged with that same number. So if you hit key 4, the fourth pair along in the Data queue — which happens to be 232,F — gets yanked out and put to work. On goes the volume in line 190, and line 200 selects the tenor voice and drops in the (N)ote line 180 produced. The other half of the pair, the actual letter C,

(continued on next page)

(continued from previous page)

then neatly drops into the Print statement in 210. So as you touch each key, you will hear a note in C major ranging from the lowest (triggered by key 1) to the highest (key 8), and receive visual confirmation of the note the Vic played. If you want to temporarily mute the sound, touch the space bar — or indeed, any key other than 1 to 8.

You can give yourself a little more selftuition in equating the Vic's tone numbers with actual note values by expanding a little on the Data items. Just as an experiment, retype

line 110 of Program 2 as follows:

110 DATA 225,C (225), 228,D (228), 231,E (231)
Run this revised version and when you hit
key 1, 2 or 3 the screen will display not only
the note name as before but also, in brackets,
the tone number used to produce that note.
This can be a useful aid when you are compiling Data statements from sheet music.

Before moving on to programmed music, using Data statements as scores on which the Vic can work, let us try brightening up the general sound produced by Program 2. Program 3 will teach you a new technique for shaping the character of the Vic's voices, as

well as producing a new tune.

As you are now entering the realm of longer and more complicated Data queues, perhaps it is worth mentioning the most common reasons why the Vic flashes up the dreaded Out of Data error message. One is that you have missed out a comma somewhere; there must be one after every Data item except the last in any one Data line. Another is that you have typed a letter O instead of the special slashed zero, 0. Out of Data will also show up if the number given in the Read loop does not match the number of items in Data.

Finally, if you are adapting any of these routines to use in a more ambitious program, remember that you may have to set up a Dim statement to reserve memory for the Read array. If you do not, you may prompt the Bad

Subscript error message.

Back to the music. Again, New the memory, and carefully type in Program 3. This sounds a little more like a piano, thanks to lines 170 to 200. These ensure that the volume of each note is heard at full volume and then dies away to nothing after the time allowed to play the (L)ength of the note in line 190. If you would like to prove to yourself that this is really happening, just add this one line to the program:

205 PRINT " [CLR SCR] " N; D; L

If all is well, the screen will display a different tone number for each note that is played, then the digit 0 and the number 31. Check through the logic of Program 3 and you should be able to understand why.

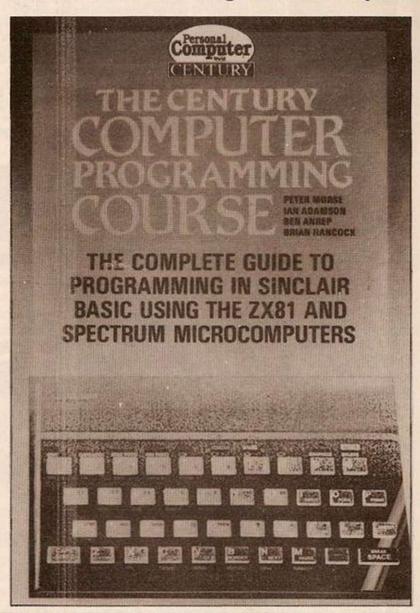
This exercise also introduces a couple of other little tricks. First, perhaps you noticed the dummy value of 0 at the end of line 120. That is because, unlike Program 2, the Read statement in line 140 simply starts at the first item of Data and doggedly works its way right through the queue, item by item. The 0 signals to the second part of line 140 that the notes are all used up and so the tune is over. Without it, the program would jam on the last note and flip up the news Out of Data Error in (continued on page 111)

Program 1. Program 4. 100 REM PROGRAM 4 100 REM PROGRAM 1 POKE 36878,10 FOR T=128 TO 254 110 DATA 215,400,217, 110 600,215,400,209, 120 130 POKE 36874, T 140 PRINT T, 600,207,400,209, 600 150 FOR D=1 TO 400 120 DATA 215,400,221, 160 NEXT D:NEXT T 600,217,400,215, 600,209,400,217, Program 2. 100 REM PROGRAM 2 600 110 DATA_225,C,228,D, 130 RESTORE 231,E 140 READ N: IF N=0 120 DATA 232,F,235,G, THEN220,0 237,A 150 READ D 130 DATA 239,B,240,C 160 POKE 36875, N 170 POKE 36878,10 FOR N=1 TO 8 140 150 READ S(N), N\$(N) 180 FOR L=1 TO 160 HEXT H D:NEXT L 170 GET K\$: IF K\$="" 190 POKE 36878,0 THEN 170 200 GOTO 140 180 N=VAL(K\$) 210 POKE 36874, 190 POKE 36878,10 0:POKE36878,0 200 POKE 36875, S(N) 220 END 220 GOTO 170 Program 6. Program 7. 100 REM PROGRAM 7 100 REM PROGRAM 6 110 N=INT(RND(1) 110 N=INT(RND(1) *129)+126 *30)+195 120 POKE 36878,10 130 POKE 36875,N 120 POKE 36878,10 130 POKE 36875, N 140 PRINT"I'M PLAYING 140 PRINT"I'M PLAYING TONE"; N TONE"; N 150 FOR D=1T0400: 150 FOR D=1T0400: NEXT D NEXT D 160 POKE 36878,0 160 POKE 36878,0 170 GOTO 110 170 GOTO 110 Program 5. 100 REM PROGRAM 5 110 DATA 201,800,209,400,225,1200,221, 800,209,400,203,1200 120 DATA 201,800,201,400,201,400,203, 400,209,400,215,1200,209,1200 130 DATA 201,800,209,400,225,1200,221 ,800,209,400,203,1200 140 DATA 201,800,209,400,209,400,215, 400,219,400,221,1200,221,1200,5 150 RESTORE 160 READ N:IF N=5 THEN 220 170 READ V 180 POKE 36878,10:POKE36876,N 190 FOR D=1 TO V:NEXTD 210 GOTO 160 220 POKE 36876,0:POKE 36878,0 230 END



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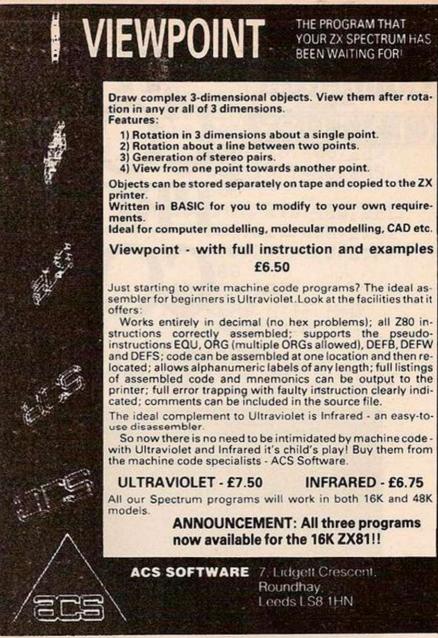
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(continued from page 108)

140. If you like, try this for yourself by cursoring out the dummy zero and then Running the

Secondly, the Restore statement in line 130 is not strictly necessary in this particular program as you have to rerun it every time you want to hear the music anyway. But usually, you will want to set Read's pointer to the head of the Data queue in line 110 in case you want to call it again; Restore does just that.

Before we go on to refine Program 3 by giving each of the notes proper values, do not overlook the creativity which lines 170 to 200 offer you. You can tinker with these along with lines 150 and 160 to get a sound more like a bar-room piano than a Bechstein, for example. Lower the 15 to 0 range of line 170 and you will soften the apparent attack; alter the Step value in the same line - even to a decimal such as .25 - and you can remould the sustain and rate of decay.

You could try adding 36876 as well, or trying different combinations of the three. Further, changing the value of the delay loop in line 190 alters the overall speed at which all this happens. This little suite of three variables is one of the most powerful tools you have in exploiting the Vic's soundmaking potential.

So Program 3 opened some new horizons, but to hear the music played properly, we need to pair every note in the Data queue with a value representing its proper duration, just as we added the letters of the scale in Program 2.

Tidy the Vic's memory by typing New and hitting Return, and this time we will have James Galway audition for Dooley Wilson's job at the Café Américain in program 4.

The deliberate error is at line 190. That Poke is chopping up the notes in a way that a flautist certainly does not do. So delete line 190 altogether and Run the program again. Now the notes do glide into one another as they should.

In this exercise I have used a value of 3,000 to the bar. It is an easy matter to quicken or slow the overall tempo at which this or any other tune is played, by simply changing proportionally the value given to each D item in Data. Thus you could accelerate Mr Galway by changing 400s to 300s, and the 600s to 450s, and so on.

But beware, this deceptively easy program has a trap for the unwary. New memory and enter Program 5.

When you Run this program, all will be well until you hear the Vic play those notes in lines 120 and 140 which are the same in tone, if not duration, of those preceding them. Just drop in a pair of zeros to achieve an imperceptible break. You may use this same trick to imitate the rests shown on sheet music. You can specify the length of the rest by giving N a proper value to work on. As an example:

DATA 201,400,0,200,201,400

will sound tone 201 for, say, a half-note; then introduce a quarter-note rest; and then play 201 for another half-note. You may also have noticed that the end of data signals at the end of lines 140 and 160 were changed to 5 from the usual 0, so that when you correct this program by adding double zeros to lines 120 and 140, your program will not end prematurely. You can go on qualifying Data lines with yet more items, provided that they are always in logical sets.

You might, for example, have the notes and durations for a melody line as elements one and two in a four item set; with a bass line and associated note durations or rests as the third and fourth elements. This way you can achieve a very effective syncopated or walking bass rhythm. For a demonstration of this technique, I can do no better than refer you to Adam Macielinski's ingenious boogie programs in the March 1983 issue of Your Computer. Adding the Vic's third voice will give you three-part harmony in a carefully structured Data queue comprising six-element items; and maybe now is the time to experiment more with Poke 36877 to drop in a snare drum.

After all that your fingers could do with a rest, so why not let the Vic get on with some composing of its own. Program 6 generates a random number between 128 and 254, which becomes the tone qualifier for line 130; and line 140 prints it out for you. The tone plays for a time set by the loop in 150 and the program then loops back for its next randomiser to give a continuous demonstration of musique silicon if not concrète.

The snag is that line 110 draws from too wide a choice of tones, many of which do not equate to real musical notes anyway. You can improve matters a little by reducing the choice for N to, say, just one middle octave. Make this alteration:

100 REM PROGRAM 7 110 N + INT(RND(1)*30) + 195.

Better, but you are still hearing some bum notes that make it sound rather strange. The best solution comes with our old friend the Data statement. New memory and enter Program 8.

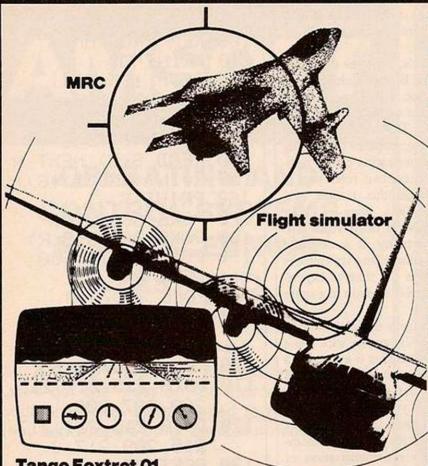
Here, lines 110, 120 and 130 set up a single octave of C major while 150 generates at random a number between 1 and 8; line 160 puts this on-screen. The volume is set in line 170, and 180 delves into the Data queue at that position fixed by R. Line 200 gives a moment of silence before looping back for the next cycle.

This program will generate music that sounds more "true" - now it is just plain monotonous thanks to line 190 sounding each note for precisely the same length of time. But it is an easy matter to introduce a further randomiser which will select different note values - the length and relationship of which you can fix. Revise the last program by changing it as follows from line 190 onwards - see Program 9.

Not stunningly elegant but it does the job. The values at the end of lines 210 to 240 you can tinker with yourself; the lower the numbers, the faster the music.

There is very much more to music making and computerised composing on your Vic 20 - not to mention the sound effects capabilities which I have not got around to examining here in any detail. Still, I hope you have fun trying, testing and adapting the programs given here and that they will help you to develop the know-how and curiosity that can result in some really original efforts of your own ones worth listening to, as well!

Program 8. 100 REM PROGRAM 8 110 PRINT"I" 120 DATA 195,201, 207,209,215, 219,223,225 130 FOR N=1 TO 8 140 READ S(N):NEXT N 150 R=INT(RND(1)*8)+1 160 PRINT R; 170 POKE 36878,10 180 POKE 36875,S(R) 190 FOR D=1 TO 600: NEXT D 200 POKE 36878,0 210 GOTO 150 Program 3. 100 REM PROGRAM 3 110 DATA 215,217,215, 209,207,209 120 DATA 215,221,217, 215, 209, 217, 0 130 RESTORE 140 READ N: IF N=0 THEN220 150 POKE 36874,N 160 POKE 36875,N 170 FOR D=15 TO 1 STEP -1 180 POKE 36878, D 190 FOR L=1 TO 30 200 NEXT L:NEXT D 210 GOTO 140 220 POKE 36874,0:POKE 36875,0:POKE 36878,0 230 END Program 9. 100 REM PROGRAM 9 110 PRINT"," 120 DATA 195,201,207, 209,215,219,223,225 130 FOR N=1 TO 8 140 READ S(N):NEXT N 150 R=INT(RND(1)*8)+1 160 PRINT R; 170 POKE 36878,10 180 POKE 36875, S(R) 190 V=INT(RND(1)*4)+1 200 PRINT V; 210 IF V=1 THEN L=150 220 IF V=2 THEN L=250 230 IF V=3 THEN L=350 240 IF V=4 THEN L=450 250 PRINT D; 260 POKE 36878,10 270 FOR D=1 TO L:NEXT 280 POKE 36878,0 290 GOTO 150



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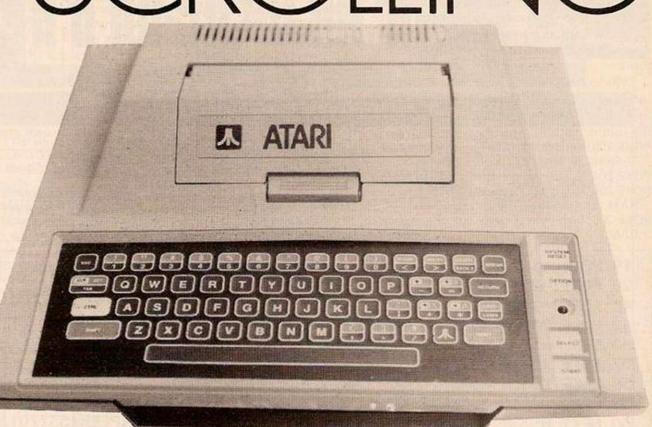
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FINE SCROLLING

ATARI

Flashing junk, nasty jerks: two of the problems that arise when using fine scrolling in Basic. Chris Lam looks at ways in which Atari users can circumvent unpleasant experiences.



WHAT IS THE difference between fine scrolling and coarse scrolling?

Coarse scrolling is where one character at a time moves. This gives a very jerky effect. Type in program 1 and Run it. The program manipulates LMS operands to implement the coarse scroll. Any method can be used: it is just that LMS manipulation is easier. The program tells Antic — the graphics processor — where to start displaying data from. It runs through addresses 0 to 65535. We will call the addresses which are Poked to tell Antic where to start displaying screen data, DList and DList+1. Try steps of 19, 20 and 21 in line 30. Change lines 20 and 30 so that they run from 255 to 0.

Just for those who do not know what LMS operands are, LMS — load memory scan — is an instruction followed by a 16-bit address. The address of the low byte is

PEEK (560) + 256*PEEK (561) + 4

Now for fine scrolling. Add program 2 to program 1. There are two built-in scroll registers HScrol — 54276 — and VScrol — 54277 — which hold the number of pixels to be scrolled. The direction of the scroll depends on the sequence of numbers we Poke into it. Before these registers can be deployed, we have to enable the lines on the screen for fine scrolling. Lines 12 and 13 do this. In line 12, the 64 is the LMS instruction, 16 is the horizontal fine scroll enabler — 32 is the

vertical scroll enabler — and 7 is the Antic number for graphics 2. Number 6 is for graphics 1, and 2 is for graphics 0.

The registers can only be used to scroll up to 15 pixels either way. Therefore we must combine fine scrolling with coarse scrolling.

Line 58 is the loop which determines the direction and the extent of scroll. A "0 to limit" gives an upwards or left-to-right scroll while a "limit to 0 step-l" gives a downward or right to left scroll. Look at figure 1 to determine the value of limit.

Line 62 resets the screen to its starting position before the coarse scroll. The value to be Poked is always the first number in line 58.

(continued on next page)

Program 1.

5 GRAPHICS 2+16

10 DLIST=PEEK (560) +256*PEEK (561)

11 DLIST=DLIST+4

20 FOR N=0 TO 255

30 FOR M=0 TO 255

40 POKE DLIST, M

50 POKE DLIST+1,N

60 FOR DELAY=1 TO 100: NEXT DELAY

70 NEXT M: NEXT N

80 END

Program 2.

5 GRAPHICS 2+16

10 DLIST=PEEK (560) +256*PEEK (561)

11 DLIST=DLIST+4

12 POKE DLIST-1,64+16+7: REM EXTRA LINE

13 FOR N=2 TO 13:POKE DLIST+N, 16+7:NEXT N:REM EXTRA LINE

20 FOR N=0 TO 255

30 FOR M=0 TO 255

40 POKE DLIST, M

50 POKE DLIST+1,N

58 FOR J=7 TO 0 STEP -1: REM EXTRA LINE

59 POKE 54276, J: REM EXTRA LINE

60 FOR DELAY=1 TO 100:NEXT DELAY

61 NEXT J:REM EXTRA LINE

62 POKE 54276, 0: REM EXTRA LINE

70 NEXT M: NEXT N

80 END

Program 3.

5 GRAPHICS 2+16

6 D=PEEK (560) +PEEK (561) #256

10 GOSUB 100

11 ACT=USR(ADR(A\$))

12 POKE D+3,64+32+16+7

13 FOR N=2 TO 13:POKE D+4+N,55:NEXT N

14 POKE D+18,65

15 POKE D+19, PEEK (560)

16 POKE D+20, PEEK (561)

18 POKE 1536, 15

(listing continued on next page)

(continued from previous page)

Before going on, see if you can convert the program to do a vertical fine scroll downwards.

Two problems arise with using fine scrolling on Basic. First is the flashing junk. Second is the unpleasant jerks. Both can be cured by changing scroll registers and LMS operands during the time which the screen is blank.

Type in program 3. The routine is enclosed in lines 101 onwards. This routine is executed fifty times a second exactly. You have to feed the routine with information.

POKE 203, number of pixels to scroll horizontally.

POKE 204, number of pixels to scroll vertically. POKE 205, low byte of new start of screen RAM.

POKE 206, high byte of new start of screen RAM.

POKE 207, low byte of DLIST.

POKE 208, high byte of DLIST.

POKE 209, if Poked with a non-zero number it will load the LMS operands with what is in location 205, 206.

POKE 1536, number you would normally have on line 73 of program 2. This is the horizontal one. POKE 1537, number you would normally have in

line 73 of program 2. This is the vertical one. This routine caters for horizontal and vertical scrolling. Program 3 demonstrates diagonal scrolling. Use this routine in your programs. You are probably saying to yourself "Who wants to watch a load of scrolling junk?". If you set up a string and manipulate LMS operands to point to the start of the string, then changing the contents of the string, we can implement coarse scroll. Try program 4.

The last program gives the skeleton on which the scrolling map in Eastern Front 1941 is created. Use your joystick to scroll the screen over nine screens full of random characters. A final warning. The computer has an internal character set which is not the same as the standard one. Such maps require a lot of careful planning before they can be created. This is all possible because screen data is not fixed to one section of memory but can be anywhere. Imagine how difficult it would be if you had to move all the data through screen ram. Program 5 uses twelve LMS instructions which is the proper set up for horizontal scrolling.

Why not try replacing MAP\$ with your own graphics?

Figure 1.

Graphics mode 0 1 2 3 4 5
Horizontal 1 unit 3 7 7 3 1 1
Vertical 1 unit 7 7 15 7 3 3

```
90 FOR N=1 TO 50: NEXT N
19 POKE 1537, 15
                                                    110 GOTO 40
20 FOR I=255 TO 0 STEP -1
40 FOR J=255 TO 0 STEP -22
                                                     Program 5
42 POKE 205, J: POKE 206, I: POKE 209, 1
50 FOR N=15 TO 0 STEP -1
                                                    3 GRAPHICS 0:POSITION 15,12:?
                                                       "PLEASE WAIT"
57 POKE 204, N
                                                    4 GOTO 10
58 POKE 203, N
                                                    5 FOR F=1 TO 60:B$(F,F)=CHR$
59 FOR K=0 TO 20: NEXT K
                                                       (PEEK (53770)): NEXT F: RETURN
60 NEXT N
                                                    10 DIM MAP$ (2160), B$ (60)
70 NEXT J
                                                    20 FOR N=1 TO 2101 STEP 60
80 NEXT I
                                                     40 GOSUB 5: MAP$ (N, N+59) =B$
90 STOP
                                                     70 NEXT N
100 REM DATA
                                                     90 BEGIN=ADR (MAP$)
101 DATA 165, 209, 240, 25, 160, 0, 165, 205, 145, 207,
    200, 165, 206, 145, 207, 173, 0, 6, 133, 203
                                                     100 GRAPHICS 2+16:ST=1536
                                                    120 FOR N=0 TO 2: POKE ST+N, 112: NEXT N
102 DATA 173, 1, 6, 133, 204, 169, 0, 133, 209, 165, 203,
                                                     130 FOR I=1 TO 12
    141, 4, 212, 165, 204, 141, 5, 212
109 DATA 76,98,228
                                                     140 POKE ST+3#1,71
110 FOR N=0 TO 41:READ A:POKE 1538+N, A:NEXT N
                                                     150 MEMST=BEGIN+(I-1) *60
                                                     155 HI=INT (MEMST/256)
120 DATA 160, 2, 162, 6, 169, 7, 32, 92, 228, 104, 96
                                                     160 POKE ST+3*I+2, HI
130 DIM A$(11)
140 FOR N=1 TO 11:READ A:A$(N,N)=CHR$(A):NEXT N 170 POKE ST+3*I+1,MEMST-HI*256
                                                     180 NEXT I
150 CO=D+4
                                                     190 POKE 1575,65
160 POKE 208, INT (CO/256)
                                                     200 POKE 1576,0
165 POKE 207, CO-INT (CO/256) *256
                                                     210 POKE 1577,6
170 RETURN
                                                     220 POKE 560,0
Program 4
                                                     230 POKE 561,6
5 GRAPHICS 2+16
                                                     1000 X=0: Y=0
10 DIM SCR$ (240), LINE$ (7)
                                                     1005 POKE 712, 10
15 SCR$(1)=" ":SCR$(240)=" ":SCR$(2)=SCR$
                                                     1010 ST=STICK(0)
16 REM IN 15 PUT CTRL J BETWEEN QUOTES
                                                     1020 IF ST=15 THEN 1010
20 LINE$="
                                                     1030 X=X+(ST=7 AND X<40)-
25 REM 20 IS CTRL J,,,,,J
                                                          (ST=11 AND X>0)
30 START=ADR (SCR$)
                                                     1040 Y=Y-(ST=14 AND Y>O)+
31 DLIST=PEEK (560) +256*PEEK (561) +4
                                                          (ST=13 AND Y<24)
32 HI=INT (START / 256)
                                                     1050 TMP=BEGIN+X+Y*60
33 POKE DLIST+1, HI
                                                     1060 FOR N=1540 TO 1573 STEP 3
34 POKE DLIST, START-HI*256
                                                     1070 HI=INT (TMP/256)
40 SVE=IN
                                                     1075 POKE N+1, HI
50 RAND=INT (RND(0) $2+1)
                                                     1080 POKE N, TMP-HI $256
60 IN=IN+(RAND=1)-(RAND=2)
                                                     1090 TMP=TMP+60
70 IF IN=-1 OR IN=14 THEN IN=SVE
                                                     1100 NEXT N
75 SCR$(1,220)=SCR$(21,240)
80 SCR$ (221+IN, 221+IN+6)=LINE$
                                                     1110 GOTO 1010
```



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CLUB EXPANDS TO INCLUDE COMMODORE 64 AND ORIC USERS

Two excellent new machines have just been added to our coverage – the Commodore 64 and the Oric. Software for these machines will be in our next Newsletter. Remember, membership is completely free of charge and you are under no obligation to buy anything from the Club unless you really want to. If you use a ZX81 (16k), Spectrum (16k or 48k), BBC (A or B), Dragon 32, Vic (expanded or unexpanded), Commodore 64 or Oric, you should join THE CLUB.

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THIS MACHINE-CODE monitor for the Dragon 32 computer offers nine commands directly accessible from the keyboard in Basic. Once installed, the monitor is called by pressing the right arrow key; this is achieved by interrupting the Dragon's key-scan routine to check whether the right arrow has been pressed. In this way the monitor can be ready for use at any time whilst being transparent to the Basic user.

When you call the monitor by pressing the right arrow key, you should get the monitor's command prompt. This is a left-pointing arrow and means that Monit32 is expecting a command. There are two other important prompts which you will need to know, these are: the "greater-than sign" which means Monit32 requires a 16-bit - four digit hexadecimal - address or length. All numbers input and output in hexadecimal. It is important to enter four characters, for example if the number 7F3 were to be entered you must type 07F3.

The other prompt is a "less-than sign" which means that Monit32 is expecting an eight-bit - two-digit hex - number. Here is a summary of the commands and their uses:

- Sets the origin address which is used by some of the other commands.
- Allows you to enter code into memory starting at the address set by O. To terminate the command enter an asterisk as the code.
- Displays the contents of a page of memory in hexadecimal starting from the address set by O. Pressing Enter will increase the address by one, pressing Clear will decrease the address by one. Pressing the space-bar returns to command level.
- This command is used to fill a section of memory with a constant. When pressed, Monit32 will first require a 16-bit length and then the value of the constant. That length of memory will then be filled with that constant starting at the address set by O.
- This is used to jump to the 16-bit address given after J.
- The M command is very useful for moving machine-code or graphics pages. When called, the monitor first requires the length of code to be moved, for example, 00FE to move 254 bytes. Then the starting address of the destination is entered. The code starting at the address set by 0 will then be copied to the memory starting at the address given for the length given.
- The contents of the 6809E microprocessor registers, A, B, X, Y, S and U (continued on next page)

These versatile routines written by Brian Cadge for the Dragon 32 provide you with a monitor which is ready for instant use whilst being invisible to the Basic user. DRAGON 32 and the transfer t

Disassembled version of the monitor.

10 CLEAR 200,31699
15 T=0:PRINT:PRINT"PLEASE WAIT A MOMENT WHILST CODEIS INSTALLED...":SOUND190,1
20 FOR I=1 TO 59:READ A\$:POKE 31999+1,VAL("&H"+A\$):T=T+VAL("&H"+A\$):NEXT
21 IF T<>5885 THEN PRINT"DATA ERROR IN 30":STOP
30 DATA 81,09,27,1,39,34,36,86,39,87,01,6A,9E,8B,86,5F,A7,89,0,0,30,1,9F,88,8D,A
0.EA,87,7F,EE,8A,40,9E,8B,A7,89,0,0,30,1,9F,88,B6,7F,EE,81,5A,26,08,86,7E,B7,01, 68,35,36,39,20,38

6A,35,36,39,20,38
50 'return value in buff+X in B
60 FOR I=60 TO 118 READ A\$ POKE 31999+I, VAL("&H"+A\$) T=T+VAL("&H"+A\$) NEXT
61 IF T<>13250 THEN PRINT"DATA ERROR IN 70" STOP
70 DATA A6,89,7F,EE,80,39,2E,0B,A6,89,7F,EE,80,30,C6,10,3D,20,0B,A6,89,7F,EE,80,37,20,F3,A6,89,7F,EF,80,39,2E,0F,A6,89,7F,EF,80,30,12,B7,7F,F2,FB,7F,F2,20,0B,A6,89,7F,EF,80,37,20,EF,39
90 'input routine for buff1-4
100 FOR I=119 TO 183 READA\$ POKE 31999+I,VAL("&H"+A\$) T=T+VAL("&H"+A\$) NEXT
101 IF T<>19267 THEN PRINT"DATA ERROR IN 110" STOP
110 DATA 7E,7D,E9,8E,0,0,BD,A0,EA,81,08,26,11,8C,0,0,27,F4,10,9E,88,31,3F,10,9F,88,30,1F,20,E8,81,0D,26,04,BD,90,A1,39,A7,89,7F,EE,8A,40,8C,00,04,24,0E,30,01,10
,9E,88,A7,A9,00,00,31,21,10,9F,88,20,C5
150 'hex Print routine val in B

```
(listing continued from previous page)
340 'exec subroutine from origin
350 FORI=395 TO 405:READA$:POKE 31999+I,VRL("&H"+A$):T=T+VAL("&H"+A$):NEXT
351 IF T<>42167 THEN PRINT"DATA ERROR IN 360":STOP
360 DATA BD.90,A1.BE.7F.FD,AD.84.7E.7D.0C
390 'examine memory form origin
400 FOR I=406 TO 542:READ A$:POKE 31999+I,VAL("&H"+A$):T=T+VAL("&H"+A$):NEXT
401 IF T<>59267 THEN PRINT"DATA ERROR IN 410/420":STOP
410 DATA 8E.0.0.86.60,A7.89.04.00.30.01.8C.02.00.26.F5.8E.04.00.9F.88.10.BE.7F.F
D.10.BF.7F.F6.86.0E.B7.7F.F5.F6.7F.F6.BD.7D.B7.F6.7F.F7.BD.7D.B7.86.09.9E.88.30.
01.9F.88.10.BE.7F.F6.E6.A4.31.21.10.BF.7F.F6.BD.7D.B7.4A.26.E8.BD.90.A1.B6.7F.F5
  .4A
420 DATA 27,05,87,75,55,20,CC,9E,88,86,6A,A7,84,30,1,95,88,8D,A0,EA,81,0D,26,0A,
 BE,7F,FD,30,01,BF,7F,FD,20,9F,81,0C,26,0R,BE,7F,FD,30,1F,BF,7F,FD,20,F0,81,20,26,DD,BD,90,R1,7E,7D,0C
 490 'move code 'M'
500 FOR I=615 TO 714 READA$ POKE 31999+I, VAL("&H"+A$) T=T+VAL("&H"+A$) NEXT
501 IF T</79939 THEN PRINT"DATA ERROR IN 510/520" STOP
510 DATA 86.7E,9E,88,87,84,30,01,9F,88,8D,7D,79,8E,0,0,8D,7D,3B,F7,7F,F5,8E,0,2,
BD,7D,3B,F7,7F,F6,86,7E,9E,88,87,84,30,01,9F,88,8D,7D,79,8E,0,0,8D,7D,3B,F7,7F,F7,8E,0,2,8D,7D,3B,F7,7F,F8,8E,7F,FD,10,8E,7F,F7,86,84,87,84,30,01,31,21,10,8F,7F
 /F7
520 DATA 10,BE,7F,F5,31,3F,10,BF,7F,F5,10,8C,0,0;26,E0,7E,7D,0C
550 'display registers 'R'
560 FOR I=1T0197'READA$'POKE 31802+I,VAL("&H"+A$)'T=T+VAL("&H"+A$)'NEXT
561 IF T<>108885 THEN PRINT"DATA ERROR IN 570/580/590"'STOP
570 DATA 35,36,BF,7F,EE,10,BF,7F,F0,10,FF,7F,F2,FF,7F,F4,B7,7F,F6,F7,7F,F7,34,36,BD,90,A1,20,16,34,2,BD,90,A1,35,2,9E,BB,A7,84,30,01,86,7D,A7,84,30,02,9F,88,39,
96,41,8D,E6,F6,7F,F6,BD,7D,B7,86,42,BD,DC,F6,7F,F7,BD,7D,B7,86,58,8D,D2,F6,7F,EE
  ,8D,7D,87
580 DATA F6,7F,EF,8D,7D,87,86,59,8D,C2,F6,7F,F0,8D,7D,87,F6,7F,F1,8D,7D,87,86,53
  ,8D,82,F6,7F,F2,8D,7D,87,F6,7F,F3,8D,7D,87,86,55,8D,82,F6,7F,F4,8D,7D,87,F6,7F,F
5,8D,7D,87,8D,90,81,8D,90,81,9E,88,86,50,87,84,30,1,86,52,87,84,30,1,86,4F,87,84
 30,1,86
590 DATA 47,87,84,30,2,9F,88,DC,18,83,0,2,93,19,FD,7F,EE,F6,7F,EE,BD,7D,B7,F6,7F
,EF,BD,7D,B7,BD,90,A1,7E,7D,0C
600 'enter code into memory 'A'
610 FOR I=1 TO 103'READA$ POKE 31699+I,VAL("&H"+A$)'T=T+VAL("&H"+A$)'NEXT
611 IF T<>122108 THEN PRINT"DATA ERROR IN 620/630"
620 DATA BD,90,A1,9E,88,86,4F,A7,84,30,01,86,7D,A7,84,30,02,9F,88,F6,7F,FD,BD,7D
,B7,F6,7F,FE,BD,7D,B7,BD,90,A1,10,BE,7F,FD,10,BF,7F,F6,9E,88,86,7C,A7,84,30,02,9
F,88,BD,7D,79,86,7F,EE,81,2A,26,03,7E,7D,0C,8C,0,0,26,0F,9E,88,86,7F,A7,84,30,1,
 9F,88
630 DATA BD,90,R1,20,D5,8E,0,0,BD,7D,3B,BE,7F,F6,E7,84,30,1,BF,7F,F6,20,C3
700 POKE 363,125 POKE 364,0
710 POKE 362,126
 720 CLS:PRINT"MONIT32 INSTALLED AND READY - PRESS RIGHT ARROW KEY TO CALL NIT32..." SOUND190,1
730 NEW
                                                                                                                                                                                                                                                                                               MO
    Program 2.
              RE-PROGRAM RESET BUTTON
   10 CLEAR 300,31099
  20 FOR I=0 TO 22:POKE 31100+I, PEEK(46159+I):NEXT
30 FOR I=23 TO 48:READA$:POKE 31100+I, VAL("&H"+A$):NEXT
40 DATA 8E.0.0.C6.01.A6.89.79.AE.A7.89.04.00.30.01.5A.26.F3.8E.04.FF.9F.88.7E.83
  50 CLS
60 PRINT
                                   "ENTER MESSAGE TO BE PRINTED WHENRESET BUTTON IS PRESSED (NO
                                                                                                                                                                                                                                                                                  INVERS
        CHARACTERS..."
0 LINE INPUT A$
                                                         " PRINT
  90 FOR I=1 TO LEN(A$)
90 POKE 31149+I,ASC(MID$(A$,I,1))OR64
100 NEXT POKE 31127,LEN(A$)
110 POKE 114,121 POKE 115,124
    120 PRINT PRINT MESSAGE ENTERED ... PRESS RESET TO TEST ... "
    Program 3.
  FOR I=0 TO 255 READ A$(I,0),A$(I,1),A$(I,2):NEXTI
PRINT"6809 DIS-ASSEMBLER FOR DRAGON 32"
PRINT:PRINT:PRINT:SOUND100,1:SOUND150,1:SOUND200,1
PS=PEEK(65314)AND1
  90 INPUT "PRINTER EP] OR SCREEN ES] ";OP$:IF OP$<>"P" AND OP$<>"S" THEN 90 ELSE
IF OP$="P" THEN PR=-2 ELSE PR=0
100 IF PR=-2 AND PS=1 THEN PRINT"ATTEND TO PRINTER!!!":EXEC 41194:GOTO 80
110 INPUT "START ADDRESS; END ADDRESS";AD,EA
120 IF EA<0 OR EA>65535 OR EA<AD OR AD<0 OR AD>65535 THEN PRINT"INVALID ADDRESS
- REDOT":GOTO70
  130 CLS:PRINT0500:PRINT#PR,"":PRINT#PR,""
140 FOR I=AD TO EA
   150 LI=I
160 SH=0
 160 SH=0
170 V=PEEK(I)
180 IF V=16 THEN SH=1:I=I+1:GOTO170
190 IF V=17 THEN SH=2:I=I+1:GOTO170
200 Z$=A$(V,SH):X$=RIGHT$(Z$,1)
210 IF X$(>"\" AND X$(>"\" AND X$(>"\" AND X$(>"\" AND X$(>\"\" AND X$(\"\" AND X$(\" AND
  230 IF X$="#" THEN 360
240 IF X$="%" THEN 380
```

(continued from previous page)

will be displayed, together with the length of any Basic program currently in the memory.

S This command executes a machine-code subroutine starting at the address given by O and then returns to the monitor.

Z Returns to Basic.

The program is used to load to monitor in reserved memory at the top of RAM. When run it will check for errors in the Data statements and inform you of any, in which case you should check through your listing against the one given. If there are no errors the monitor is installed and the loading program is Newed.

As previously mentioned, the program interrupts the key-scan routine to check if the arrow key has been pressed. Anybody interested in writing programs to use this — for example, a keyboard beep routine — will need to know the following.

Locations 363 and 364 contain the address to which the Dragon jumps when a key is pressed. To enable the interrupt, location 362 is Poked with 126, to disable the interrupt a value of 57 is Poked to location 362.

The second short program demonstrates how the Reset button can also be interrupted when pressed. The program asks for a message to be typed in and this message will then be printed before the OK prompt when ever the Reset key is pressed. This is achieved by changing locations 114 and 115 which point to the address to which the Dragon will jump when the Reset key is pressed.

It is important that the machine recovers correctly, so part of the Reset routine is copied from the ROM first of all in line 20, then your own machine-code program can follow this.

Finally, one very useful command that is missing from the Dragon's Basic is the Merge facility. However, this can be achieved as follows: type Cload "programone". When loaded type

? PEEK(25); PEEK(26); PEEK(27); PEEK(28)

Make a note of the four numbers displayed.

Type

POKE 25, PEEK(27): POKE 26, PEEK(28)-2
Now Cload "programtwo". Renumber it so
that its first line number is higher than the last
line number of the first program. Finally,
Poke locations 25 and 26 with the original
values. The programs should now have been
merged. This works as locations 25 and 26
contain the Start address of the program and
locations 27 and 28 contain the end address
plus two of the program. This information can
also be used to clear all of the graphics pages;
usually you must have at least one page
reserved. Type in

POKE 25,6 : NEW

and you will have just under 31K of free memory. Make sure that there is no program in the memory before you do this or it will create chaos.

Program 3 is a full 6809 disassembler program designed to run on the Dragon 32. Note that the program can be used with or without the printer, the only difference in output being that the hexadecimal code is also output to the printer whereas only the address and mnemonic is printed when disassembling to the screen.

All of the mnemonics are held in Data

statements at the end of the program in lines 890 onwards. Take care when entering these to insert the correct number of commas between each word as this is very important.

The symbol after each mnemonic signifies to which addressing mode, if any, the op-code refers; for example a "greater than" symbol means indexed addressing.

The main loop is from lines 140 to 350, this prints the correct mnemonic and transfers control to one of the subroutines to print any following data.

The use of Print with a channel number means that exactly the same program can be used for both the screen and printer. Line 90 sets PR to 0 for the screen, or -2 for the printer.

Line 30 sets up an 80-column printer, and although Dragon Data never mention this, this line should be included with any program that is going to use a printer.

Use Shift @ to halt the disassembly as the text scrolls up the screen at quite a pace. If you use the program to disassemble the Basic ROM it is quite easy to find some very useful subroutines that can be called from your own Basic or machine-code programs. For example, try entering the starting address as 48299 and you will get a disassembly of the ROM's print routine, which prints the character in register A.

```
31700
                            JSR ( 37025 )BD90A1
31700
31703
31705
31707
31709
31711
31713
31715
31717
                                       LDX ( 136
LDA 79
STR EX3
LER X 1
                                                                                        9E88
                                                                                       864F
8784
                                      LER X 1

LDR 125

STR EXJ

LER X 2

STX ( 136 )

LDB ( 32765 )

JSR ( 32183 )

LDB ( 32766 )

JSR ( 32183 )

JSR ( 32183 )

JSR ( 32183 )

JSR ( 32765 )

LDY ( 32765 )

STY ( 32758 )

LDX ( 136 )

LDA 124
                                                                                        3001
                                                                                       867D
8784
                                                                                        3002
                                                                                        9F88
F67FFD
                                                                                        BD7DB7
31725
31728
                                                                                        F67FFE
BD7DB7
31731
31735
31739
31742
31744
31746
31748
31750
31752
31755
31758
                                                                                        BD90R1
                                                                                        10BE7FFD
                                                                                        108F7FF6
                                                                                        9E88
                                      LDA 124
STR EXJ
                                       LER X 2
STX ( 136 )
                                                                                        3002
                                JSR ( 32.

JSR ( 32.

LDR ( 3275b

CMP R 42

BNE + 3

JMP ( 32012 )

CMP X 0

BNE + 15

LDX ( 136 )

127
                                                                                        9F88
                                                                                        BD7D79
B67FEE
                                                                                        812R
                                                                                        2603
7E7D0C
8C0000
 31760
31762
31765
31768
31770
31772
31776
31776
31778
31780
31783
31783
31783
31784
                                                                                        260F
                                                                                        9E88
867F
8784
                                      LEA X 1
STX ( 136 )
JSR ( 37025 )
BRA - 43
                                                                                        3001
                                                                                        9F88
BD9ØR1
                                                                                        20D5
                                                                                        8E0000
                                       LDX
                                                 8
                                       JSR ( 32
LDX ( 32
STB Ex]
                                                     32059 )
32758 )
                                                                                        BD7DBB
BE7FF6
                                                                                        E784
31796
31798
                                                                                        3001
BF7FF6
                                       LER X 1
STX ( 32758 >
                                      PULS 00110110 BIN
STX ( 32750 )
STY ( 32752 )
STS ( 32754 )
 31801
                                       BRA .
                                                    61
                                                                                        20C3
31803
31805
31809
                                                                                        3536
                                                                                       3536
BF7FEE
10BF7FF0
10FF7FF2
FF7FF4
B77FF6
F77FF7
 31813
                                       STU ( 32756 )
STR ( 32758 )
STB ( 32759 )
PSHS 00110110 BIN
31816
31819
31822
                                                                                        3435
 31825
                                       JSR ( 37025 )
BRA + 22
                                                                                        8098A1
2016
 31827
 31838
                                       PSHS 00000010 BIN
                                                                                        3402
 31834
                                        JSR ( 37025
                                                                                        BD9081
                                                                                        3502
9E68
                                        PULS 00000010 BIN
31837
31839
31841
                                       LDX ( 196 )
STA EXJ
LER X 1
LDR 125
STA EXJ
                                                                                        R784
31843
31845
31847
31849
                                                                                        3001
867D
                                                                                        8784
3882
                                       LEA
                                       STX ( 136 )
RTS
                                                                                        9F88
39
                                                 65
                                                    26
                                                                                        ADE6
                                               (continued on next page)
```

```
IF X$="&" THEN
IF X$="\" THEN
IF X$="\" THEN
IF X$="\" THEN
                                                             438
278
                                                             680
290
            IF X$="/" THEN 820
IF PR=0 THEN 350
 310
 320 PRINT#PR,TAB(36); FOR JJ=LI TO I:HE$=HEX$(PEEK(JJ)):IF LEN(HE$)<2 THEN HE$="
 0"+HE$
  330 PRINT#PR, HE$;
340 NEXT JJ
350 PRINT#PR,"":NEXTI:END
360 I=I+1:V=PEEK(I):PRINT#PR,V;
370 GOTO 310
            I=I+1:V=PEEK(I)*256+PEEK(I+1):I=I+1:PRINT#PR,V;
            GOTO 310
I=I+1:V=PEEK(I)
PRINT#PR,"("V")";
420 GOTO 310
430 I=I+1:V=PEEK(I)*256+PEEK(I+1):I=I+1
             PRINT#PR. "C "V" )",
450 GOTO310
460 I=I+1
470 V=PEEK(I)
             PRINT#PR
                                            "E";
            V=V AND 96
IF V=0 THEN P$="X"
IF V=32 THEN P$="Y"
IF V=64 THEN P$="U"
IF V=96 THEN P$="S"
PRINT#PR,P$;" ";
 490
500
  510
 520
  530
 540
              IF (PEEK(I)AND128)=0 THEN PRINT#PR,"+";(PEEK(I)AND31);"3"; GOTO670
              V=PEEK( I )AND159
 560
570 IF V=132 THEN PRINT#PR," "; GOTO670
580 IF V=136 THEN PRINT#PR,"+"; GOTO360
590 IF V=137 THEN PRINT#PR,"+"; GOTO380
600 IF V=134 THEN PRINT#PR,"+AJ"; GOTO670
610 IF V=134 THEN PRINT#PR,"+HJ"; GOT0670
610 IF V=133 THEN PRINT#PR,"+BJ"; GOT0670
620 IF V=139 THEN PRINT#PR," INC 13";
630 IF V=128 THEN PRINT#PR," INC 13";
640 IF V=129 THEN PRINT#PR," INC 23";
650 IF V=130 THEN PRINT#PR," DEC 13";
660 IF V=131 THEN PRINT#PR," DEC 23";
 670 GOT0310
680 I=I+1:V=PEEK(I)
690 P$=""
 690
 700 FOR J=7
710 IF VKIN
                        ! J=7 TO 0 STEP-1
V<INT(2^J) THEN P$=P$+"0" ELSE V=V-INT(2^J):P$=P$+"1"
 720 NEXTJ
 730 PRINT#PR, P$" BIN";
 740 GOTO310
750 I=I+1:V=PEEK(I)
 760 IF V>127 THEN 790
770 PRINT#PR,"+"V;
 780 GOTO810
790 V=256-V
            PRINT#PR, "-"V;
810 GOTO 310
820 I=I+1:V=PEEK(I)*256+PEEK(I+1):I=I+1
830 IF V>32767 THEN 860
840 PRINT#PR,"+"V;
 850 GOTO880
 370 PRINT#PR, "-"V,
            G0T0310
880 GOTO310
890 DATA NEG $,,,ERR,,,ERR,,,COM $,,,LSR $,,,ERR,,,ROR $,,,ASR $,,,ASL $,,,ROL $
,,,DEC $,,,ERR,,,INC $,,,TST $,,,JMP $,,,CLR $,,,SFT,,,SFT2,,,NOP,,,SYNC,,,ERR,,
,ERR,,,ERR,,,LBRS %,,
900 DATA ERR,,,DAA,,,OR CC #,,,ERR,,,AND CC #,,,SEX,,,EXG <,,,TFR <,,,BRA ^,LBRA 
/,,BRN ^,LBRN /,,BHI ^,LBHI /,,BLS ^,LBLS /,,BHS ^,LBHS /,,BLO ^,LBLO /,BNE ^,
LBNE /,BEQ ^,LBEQ /,BVC ^,LBVC /,BVS ^,LBVS /,BPL ^,LBPL /,,BMI ^,LBMI /,BG
E ^,LBGE /,
910 DATA BLT ^,LBLT /,BGT ^,LBGT /,BLE ^,LBLE /,LEA X >,,LEA Y >,,LEA S >,,
LEA U >,,PSHS <,,PULS <,,PSHU <,,PULU <,,ERR,,RTS,,ERR,,RTI,,CWAI #,,,
MUL.,ERR,,SWI 1,SWI 2,SWI 3,NEG A,,ERR,,ERR,,COM A,,
920 DATA LSR A,,ERR,,ROR A,,ASR A,,ASL A,,ROL A,,DEC A,,ERR,,INC A,,TST
A,,ERR,,CLR A,,NEG B,,ERR,,ERR,,COM B,,LSR B,,ERR,,ROR B,,ASR B,,ASL
B,,ROL B,,DEC B,,ERR,,INC B,,TST B,,ERR,,CLR B,,NEG >,,ERR,,ERR,,COM
930 DATA LSR >,,,ERR,,,ROR >,,,ASR >,,,ASL >,,,DEC >,,,ERR,,,INC >,,,TST >,,,JMP >,,,CLR >,,,NEG &,,,ERR,,,COM &,,,LSR &,,,ERR,,,ROR &,,,ASR &,,,ASL &,,,ROL &,,,DEC &,,,ERR,,,INC &,,,TST &,,,JMP &,,,CLR &,,,SUB A #,,,CMP A #,,,SBC A #,,
940 DATA SUB D %,CMP D %,CMP U %,AND A #,,,BIT A #,,,LDA #,,,ERR,,,EOR A #,,,ADC A #,,,OR A #,,,ADD A #,,,CMP X %,CMP Y %,CMP S %,BSR ^,,,LDX %,LDY %,ERR,,,SUB A $,,,CMP A $,,,SUB D $,CMP D $,CMP U $,AND A $,,,BIT A $,,,LDA $,,,S
TA $,,
950 DATA EOR A $,,,ADC A $,,,OR A $,,,ADD A $,,,CMP X $,CMP Y $,CMP S $,JSR $,,,
LDX $,LDY $,,STX $,STY $,,SUB A >,,,CMP A >,,,SBC A >,,,SUB D >,CMP D >,CMP U >,
AND A >,,BIT A >,,,LDA >,,,EOR A >,,,ADC A >,,,ADC A >,,,ADD A >,,
960 DATA CMP X >,CMP Y >,CMP S >,JSR >,,,LDX >,LDY >,,STX >,STY >,,SUB A &,,,CMP
A &,,,SBC A &,,,SUB D &,CMP D &,CMP U &,AND A &,,,BIT A &,,,LDA &,,,STA &,,,EOR
A &,,,ADC A &,,,OR A &,,,ADD A &,,,CMP X &,CMP Y &,CMP S &,JSR &,,,LDX &,LDY &,
970 DATA STX &,STY &,,SUB B #,,,CMP B #,,,SBC B #,,,ADD D %,,,AND B #,,,BIT B #,
,,LDB #,,,ERR,,,EOR B #,,,ADC B #,,,ADD D $,,,AND B #,,,BIT B $,,
980 DATA LDB $,,,STB $,,,EOR B $,,,ADC B $,,,ADD B $,,,ADD B $,,,STD $,,,
LDU $,LDS $,,STU $,STS $,,SUB B >,,,CMP B >,,,ADD D >,,,ADD D >,,,AND B >,,,BIT $,,
LDU $,LDS $,,STU $,STS $,,SUB B >,,,CMP B >,,,ADD >,,,LDD >,,,STD >,,,LDU >,,LDS >,,
LDS >,,,STB >,,,EOR B >,,,ADC B >,,,ADD >,,,LDD >,,,STD >,,,LDU >,,,LDU >,,LDS >,,
LDS >,,,STB >,,,EOR B >,,,ADC B >,,,ADD >,,,LDD >,,,STD >,,,LDU >,,LDS >,,
LDS >,,,STB >,,,EOR B >,,,ADC B >,,,ADD >,,,LDD >,,,STD >,,,LDU >,,LDS >,,
LDS >,,,STB >,,,EOR B >,,,ADC B >,,,ADD >,,,LDD >,,,STD >,,,LDU >,,,LDU >,,LDS >,,
LDS >,,
    LDS
990 DATA STU >,STS >,,SUB B &,,,CMP B &,,,SBC B &,,,ADD A &,,,AND B &,,,BIT B &,,,LDB &,,,STB &,,,EOR B &,,,ADC B &,,,OR B &,,,ADD B &,,,LDD &,,,STD &,,,LDU &,LDS &,,STU &,STS &,
```

Construction of the Constr								
Western and the second	d from province popul	-1	32139	LER Y 63	313F	32416	CMP X 512	802200
	ed from previous page		32142	STY (136)	109F88	32419	BNE - 11	26F5
31858		F67FF6 BD7DB7	32144	LEA X 31	381F	32421	LDX 1024	8E0400
31861 31864	JSR (32183) LDR 66	8642	32146	BRA - 24	20E8	32424	STX (136)	9F88
31866	BSR - 36	8DDC	32148	CMP R 13	8100	32427	LDY (32765) STY (32758)	108E7FFD 108F7FF6
31868		F67FF7	32150	BNE + 4	2504 BD9081	32431 32434	LDR 14	868E
31871	JSR (32183)	B070B7	32152 32155	JSR (37025) RTS	39	32436	STR (32757)	B77FF5
31874	LDA 88	8658	32156	STR Ex + 32750 3	A7897FEE	32439	LDB (32758)	F67FF6
31876	BSR - 46 LDB (32750)	F67FEE	32160	OR R 64	8R48	32442	JSR (32183)	BD7DB7
31878	JSR (32183)	BD7DB7	32162	CMP X 4	800004	32445	LDB (32759)	F67FF7 BD7DB7
31884		F67FEF	32165	BHS + 14	240E	32448 32451	JSR (32183) LDR 9	8609
31887	JSR (32183)	BD7DB7	32167 32170	LEA X 1	3001 109E89	32453	LDX (136)	9836
31890	LDR 89	8659	32172	LDY (136) STR Ey + 8 3	A7A90000	32455	LER X 1	3001
31892	BSR - 62	BDC2	32176	LER Y 33	3121	32457	STX (136)	9F88
31894		F67FF0	32179	STY (136)	109F88	32468	LDY (32758)	108E7FF6
31897	JSR (32183) LDB (32753)	BD70B7 F67FF1	32181	BRA - 59	2005	32463	LDB Ev3	E6R4
31900	JSR (32183)	BD7DB7	32183	STB (32767)	F77FFF	32465	LER Y 33	3121
31906	LDR 83	8653	32186	LSR B	54	32468	STY (32758) JSR (32183)	10BF7FF6 BD7DB7
31988	BSR - 78	8DB2	32187	LSR B	54	32471 32474	JSR (32183) DEC R	48
31910	LDB (32754)	F67FF2	32188	LSR B	54 54	32475	BNE - 24	26E8
31913	JSR (32183)	BD7D87	32189 32198	. LSR B RND B 15	C4ØF	32477	JSR (37025)	BD98A1
31916	LDB (32755)	F67FF3	32192	CMP B 9	C109	32488	LDR (32757)	B67FF5
31919	JSR (32183)	807087 8655	32194	BGT + 4	2E04	32483	DEC A	48
31922 31924	LDR 85 BSR - 94	8DR2	32196	ADD B 112	CB70	32484	BEQ + 5	2785
31926	LDB (32756)	F67FF4	32198	BRA + 2	2002	32486	STR (32757)	B77FF5
31929	JSR (32183)	BD7DB7	32200	ADD B 55	CB37	32489	BRA - 52	20CC 9E88
31932	LDB (32757)	F67FF5	32202	BSR + 18	BD12	32491 32493	LDX (136) LDA 106	866A
31935	JSR (32183)	BD7DB7	32204	LDB (32767)	F67FFF	32495	EX3 RTS	8784
31938	JSR (37025)	BD90A1	32207	RND B 15 CMP B 9	C40F C109	32497	LER X 1	3881
31941	JSR. (37025)	BD90A1	32209 32211	BGT + 4	2E04	32499	STX (136)	9F88
31944 31946	LDX (136)	9E88 8650	32213	ADD B 112	C870	32501	JSR (41194)	BDROER
31948	STA EXI	A784	32215	BRA + 2	2002	32504	CMP A 13	8100
31950	LER X 1	3001	32217	ADD B 55	CB37	32506 32508	BNE + 18	260A BEZEED
31952	LDA 82	8652	32219	BSR + 1	8001	32511	LDX (32765) LEA X 1	BE7FFD 3001
31954	STA Ex3	A784	32221	RTS	39	32513	STX (32765)	BF7FFD
31956	LER X 1	3001	32222	LDX (136) STB Ex + 0 J	9E88 E7890000	32516	BRA - 97	209F
31958	LDR 79	864F	32224 32228	STB Ex + 0 J	3001	32518	CMP A 12	818C
31960	EX3 ATS	9784 3001	32230	STX (136)	9F88	32520	BNE + 10	260R
31962 31964	LER X 1 LDR 71	8647	32232	RTS	39	32522	LDX (32765)	BE7FFD
31966	STR Ex3	R784	32233	CMP R 79	B14F	32525	LER X 31	301F
31968	LER X 2	3002	32235	BNE + 3	2603	32527 32538	STX (32765) BRR - 16	BF7FFD 20F0
31970	STX (136)	9F88	32237	JMP (32307)	7E7E33	32532	BRR - 16 CMP R 32	8128
31972	LDD (27)	DC1B	32248	CMP R 74 BNE + 3	814R 2603	32534	BNE - 35	26DD
31974	SUB D 2	830002	32242 32244	JMP (32343)	7E7E57	32536	JSR (37025)	BD9081
31977	SUB D (25)	9319 FD7FEE	32247	CMP A 83	8153	32539	JMP (32012)	7E7D0C
31979	STD (32750)	F67FEE	32249	BNE + 3	2603	32542	LDA 126	867E
31982 31985	LDB (32750) JSR (32183)	BD7DB7	32251	JMP (32394)	7E7E8A	32544	LDX (136)	9E88
31988	LDB (32751)	F67FEF	32254	CMP A 69	8145	32546	STR EXI	A784
31991	JSR (32183)	807087	32256	BNE + 3	2603	32548	LER X 1 STX (136)	3001 9F88
31994	JSR (37025)	BD90R1	32258	JMP (32405)	7E7E95	32550 32552	STX (136) JSR (32121)	BD7D79
31997	JMP (32012)	7E7D0C	32261	CMP A 70	8146 2603	32555	LDX 0	9E0000
32000	CMP A 9	8109	32263 32265	BNE + 3 JMP (32542)	7E7F1E	32558	JSR (32059)	BD7D3B
32002	BEQ + 1	2701	32268	CMP R 77	814D	32561	STB (32757)	F77FF5
32004 32005	RTS PSHS 00110110 BIN	39 3436	32278	BNE + 3	2603	32564	LDX 2	8E0002
32007	LDR 57	8639	32272	JMP (32614)	7E7F66	32567	JSR (32059)	BD7D3B
32009	STR (362)	B7016A	32275	CMP A 82	8152	32578	STB (32758) LDX (136)	F77FF6
32012	LDX (136)	9E88	32277	BNE + 3	2603	32573 32575	LDX (135) LDR 124	9E88 867C
32014	LDR 95	865F	32279	JMP (31803) CMP A 65	7E7C3B 8141	32577	STA EX3	A784
32016	STR Ex + 0 3	A7890000	32282 32284	BNE + 3	2603	32579	LEA X 1	3001
32020	LER X 1	3001	32286	JMP (31700)	7E7BD4	32581	STX (136)	9F88
32022	STX (136)	9F88	32289	LDX (136)	9E88	32583	JSR (32121)	BD7D79
32024	JSR (41194)	BDAGEA	32291	LDA 127	867F	32586	LDX 8	8E0000 BD7D3B
32027 32030	STR (32750) OR R 64	B77FEE 8R40	32293	STA Ex + 0 3	A7890000	32599 32592	JSR (32859) LDX (32765)	BE7FFD
32032	LDX (136)	9E88	32297	LER X 1	3001	32596	LDY (32757)	10BE7FF5
32034	STA Ex + 0 3	A7890000	32299	STX (136)	9F88 BD90A1	32599	STB Ex3	E784
32838	LEA X 1	3001	32301 32304	JSR (37025) JMP (32012)	7E7D0C	32601	LER X 1	3001
32040	STX (136)	9F88	32307	LDX (136)	9E88	32603	LEA Y 63	313F
32042 32045	LDR (32750) CMP R 90	867FEE 815A	32309	LDA 126	967E	32606 32609	CMP Y 0 BNE - 12	108C0000 26F4
32045	BNE + 8	2608	32311	STR Ex + 0 3	A7890000	32611	JMP (32012)	7E7D0C
32049	LDR 126	867E	32315	LER X 1	3001	32614	LDR 126	867E
32051	STA (362)	B7016R	-32317	STX (136) -	9F88	32616	LDX (136)	9E88
32854	PULS 00110110 BIN	3536	32319 32322	JSR (32121) LDX Ø	BD7D79 8E0000	32618	EX3 RTS	A784
32056	RTS	39	32325	JSR (32059)	BD7D3B	32628	LER X 1	3001 9F88
32057 32059	BRA + 59	203B 86897FEE	32328	STB (32765)	F77FFD	32622 32624	STX (136) JSR (32121)	BD7D79
32059	LDR Ex + 32750] SUB R 57	8039	32331	LDX 2	8E0002	32627	LDX 8	8E0000
32065	BGT + 11	2E0B	32334	JSR (32059)	BD7D3B	32638	JSR (32059)	BD7D3B
32067	LDA Ex + 32750 3	A6897FEE	32337	STB (32766)	F77FFE	32633	STB (32757)	F77FF5
32071	SUB A 48	8030	32348 32343	JMP (32012) LDX (136)	7E7D0C 9E88	32636	LDX 2	8E0002
32073	LDB 16	C610	32343	LDR 126	867E	32639	JSR (32059) STB (32758)	BD7D3B
32075 32076	MUL BRA + 8	3D 2008	32347	STR Ex + 0 3	A7890000	32642 32645	LDA 126	F77FF6 867E
32078	LDA Ex + 32750 3	A6897FEE	32351	LER X 1	3001	32647	LDX (136)	9E88
32082	SUB A 55	8037	32353	STX (136)	9F88	32649	STA EX3	A784
32084	BRA - 13	20F3	32355	JSR (32121)	807079	32651	LEA X 1	3001
32086	LDA Ex + 32751 3	A6897FEF	32358	CMP X 0	808888	32653	STX (136)	9F88
32898	SUB A 57 BGT + 15	8039	32361	BGT + 3	2E03	32655	JSR (32121)	8D7D79 8E0000
32892 32894	LDA Ex + 32751 3	2E0F R6897FEF	32363 32366	JMP (32012)	7E7D0C 8E0000	32658 32661	LDX 0 JSR (32059)	BD7D3B
32098	SUB A 48	8030	32369	JSR (32059)	BD7D3B	32664	STB (32759)	F77FF7
32100	NOP	12	32372	STB (32392)	F77E88	32667	LDX 2	8E8883
32181	STA (32754)	B77FF2	32375	LDX 2	8E0002	32670	JSR (32059)	BD7D3B
32104	ADD B (32754)	FB7FF2	32378	JSR (32059)	BD7D3B	32673	STB (32760)	F77FF8
32187 32189	BRA + 8 LDA Ex + 32751 3	2008 R6897FEF	32381 32384	STB (32393) LDR 126	F77E89 867E	32676 32680	LDX (32765) LDY (32759)	BE7FFD 10BE7FF7
32113	SUB A 55	8037	32386	STR (362)	B78168	32683	LDR EX3	R684
32115	BRA - 17	20EF	32389	PULS 00110110 BIN	3536	32685	STA EVI	A784
32117	RTS	39	32391	JMP (33649)	7E8371	32687	LER X 1	3001
32118	JMP (32233)	7E7DE9	32394	JSR (37025)	BD90A1	32689	LEA Y 33	3121
32121	LDX 0	8E0030	32397	LDX (32765)	BE7FFD	32692	STY (32759)	10BF7FF7
32124	JSR (41194) CMP R 8	BDAGEA 8188	32400 32402	JSR [x] JMP (32012)	ADB4	32696	LDY (32757) LER Y 63	108E7FF5
		2611	32402	TDX 8	7E700C 8E0000	32699 32782	STY (32757)	10BF7FF5
32127	BNE + 17						011 (02101)	
32129 32131	CMP X 0	808888	32408	LDR 96	8668	32726	CMP Y Ø	18808888
32129 32131 32134	CMP X Ø BEQ - 12	8C0000 27F4	32410	STA Ex + 1024 3	R7898488	32786 32789	BNE - 32	26E0
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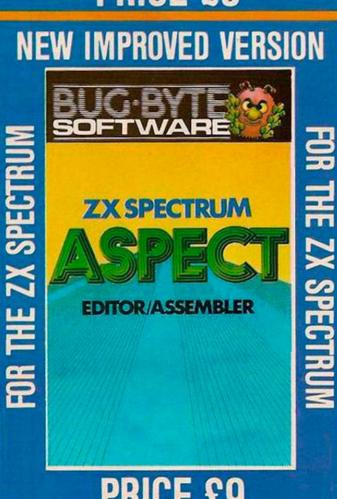
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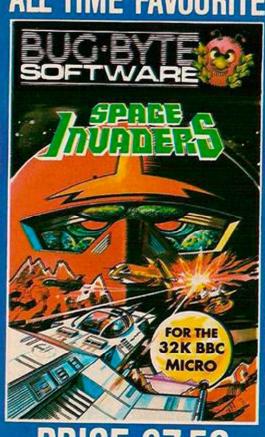
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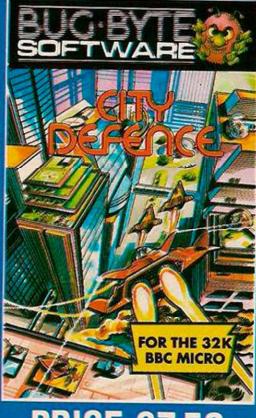
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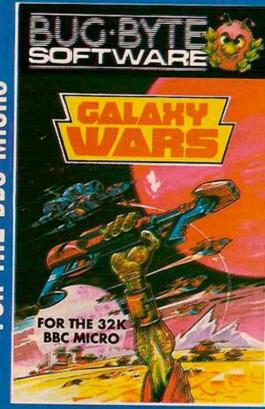
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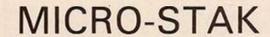
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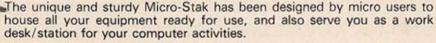
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IF YOU ENTERED the programs last month, then you may have been perturbed by the speed of them: how can we slow them down?

The most common method is using a delay subroutine like the one in figure 1.

This is a delay loop. It works by introducing a delay of around 0.5 seconds each time it is called. Unfortunately, it resets the X and Y registers to 0, which in a program where X and Y are used extensively is not a good idea. To get around this we grab two free memory bytes and use them as variables. This makes the program a bit harder to understand, but now X and Y are not changed within the subroutine.

Any two free memory bytes will do. I used \$FE and \$FF - 254 and 255 - in the example in figure 2 as they are not used on the Vic-20, but any two will do.

We still have the same overall effect, but X and Y remain unchanged. Unfortunately we had to use the accumulator, but this is excusable as 90 percent of all machine-code subroutines use it and so it is unwise to store anything of importance in there for too long a time. So we have a delay loop. Let us add it to our sound program of last month. See figure 3.

Line 100 in last month's loader would now read:

100 DATA A9,00,8D,0E,90, A2,FF,A0,00,CA, 8E,0A,90,8C,0B,90,20,42,1A

102 DATA C8,D0,F3,60,A9,00,85,FE,85,FF,E6, FF,D0,FC,E6,FE,D0,F6,60

An important point to note is that the branch instruction in the sound section has changed from last month so as to obtain a better effect. As we have added a JSR instruction into our loop, we have added three extra bytes of code, so the branch has altered correspondingly. To run it, type in SYS 6700 and you will experience some weird effects.

This is what we call reading the memory and not remembering the post-code. So far three types of command have been used: first, commands which do not have an operand, for example INY and DEX. Second, branch instructions which precede a displacement rather than an actual memory address. Third, Jump commands — JSR — which precede a memory location. Fourth, commands which access the contents of a specified address.

This is just the tip of the iceberg; there are seven different ways of addressing memory: immediate, absolute, zero page, relative, indirect, indirect pre-indexed with X, and implied-implied addressing.

In immediate addressing the actual value of the operand is manipulated. The immediate addressing is expressed by putting a hash sign in front of the operand. Thus,

LDA # 5

means load the accumulator with 5, or in Basic A=5. With absolute addressing we Load from, Add to or Store into an address which is stored in two bytes immediately after the opcode. So

LDA 2048

means load the accumulator with the value stored in byte 2048, or, in Basic, A=Peek (2048).

Zero-page is absolute addressing except that all the locations are in zero-page — bytes 0 to 255 — inclusive. As one byte can hold values of 0 to 255, the zero-page addressing requires two bytes, op-code and address. In this case,

Darryl Mattocks continues his guide to 6502 machine code.

AACHINE

LDA 38

means load the accumulator with the value stored in byte 0038. The Basic equivalent is simply

A = PEEK(3*16+8)

Relative addressing is the type of addressing used in branch statements, that is, a displacement which is added to or subtracted from the program counter.

BEQ 3A

means if the zero flag is set -Z=1 — in the status register then skip 3A bytes of memory. There is no direct equivalent to this in Basic, but if we imagined that * symbolished the current line of code being executed, then

10 REM

20 X = X-1

30 IF X=0 THEN *= *-10:REM GOTO 20

With the indirect post-indexed with Y addressing technique, the contents of the byte specified in the operand and the following byte are converted into an address. The contents of Y are then added to this address and it is then this address that is manipulated. The indirect with Y is symbolised by brackets around the Operand and then a",Y" outside the bracket to indicate that it is post- and not pre-indexed; for example:

L'DA (32), Y

If Y is equal to 12 decimal, byte 32 is equal to 41 decimal and byte 33 is equal to 22 decimal.

Then the accumulator would be loaded with the contents of byte 5685 — where

5685 = 12 + 41 + 22*256

In Basic this would appear as A = PEEK (PEEK(32) + 256*PEEK(33) + Y)

Indirect — pre-indexed with X addressing is similar to the previous case except now we add the contents of the X register to the operand and then take this new operand as the address of the first byte of the final address acquired. The symbolism for this type of addressing is again the brackets around the Operand but now we put a X inside the brackets:

LDA (32,X)

If X=4, byte 36=201 and byte 37=21 then the accumulator would be loaded with the contents of byte 5577, where

5577 = 201 + 21*256

In Basic this would look something like A = PEEK(PEEK(32 + x) + 256*PEEK(32 + x))

Implied-implied addressing requires no operand and often has very little to do with the memory at all. The op-codes in this category are mainly for changing the data in the registers. Thus INY means increment the Y register:

Y = Y + 1

If one byte can contain 256 different values, then how can a computer access a memory of 65,536 — 64K — bytes? The answer is to use two bytes to represent each address.

So using two bytes for every address, we can have a total of 256 multiplied by 256 — 64K — different addresses. It is no coincidence, then, that if you add up the total amount of RAM memory and ROM memory you get 64K. Some computers such as the CBM-64 use what is known as a virtual memory system whereby the computer splits the memory up into lots of 16K blocks and then pretends to only have 16K at a time.

(continued on next page)

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An address is made up of two bytes: Hi-byte — or page number, where one page is 256 bytes and 256 pages is 64K — and another byte to represent one particular byte out of the 256 in one page, the Lo-byte.

Life is made simpler if hexadecimal is used throughout, as by definition in a hex number such as 1234. The page number is 12 leaving the 34 as the Lo-byte or byte number. The best way to convert a decimal number into a machine-code address — if the computer is at hand — is to go through the following sequence. For example, 10845 decimal is equal to.

PRINT INT(10845/4096) = 2 = 2 PRINT (10845-2*4096) = 2653 PRINT INT(2653/256) = 10 = A PRINT (2653-10*256) = 93 PRINT INT(93/16) = 5 = 5 PRINT (93-5*16) = 13 = D = 2A5D hex

The convention for storing addresses in machine code is that they should always be in a Lo-byte, Hi-byte order. So 10845 would be stored as 5D,2A and not as 2A,5D.

A program with all two-byte addresses will be slower to run than one containing only one-byte addresses, but having only one byte to represent an address means a maximum 255—one page—of memory. To speed things up, we take the first 256 bytes of memory—0000 00FF—and call them the zero-page—due to the page number being equal to zero.

A lot of both business and games programs use machine code to move through memory one byte at a time. Word processors have a cursor rushing through sheets of text and

Figure 1.			Figure 3.			
OPCODE 82 88 88 88 C8 D0 FD	MNEMONIC CDX #8 LDY #8 INY BNE FD	BASIC EQUIVALENT 18 X=0 20 Y=0 30 Y=Y+1 40 IF YC> 256 THEN 30	MEMORY LOGRITION 182C 182E 1831	OPCODE R9 00 8D 0E 90 R2 FF	MNEMONIC ELDR #0F STA 900E LDX #FF	BASIC 10 R=15 20 POKE 36878,R 30 X=255
E8 D0 F8 60	INX BNE F8 RTS	50 X=X+1 60 1F XC> 256 THEN 20 70 RETURN	182E 1831 1833 1835 1836 1839 183C 183F	R0 00 CR SE 0R 90 8C 0B 90 20 42 1R C8	LDY #8 DEX STX 900R STY 900B JSR 1842 INY	40 Y=0 50 X=X-1 60 POKE 36874,X 70 POKE 36875,X 80 GOSUB 120 90 Y=Y+1
Figure 2.		CONTRACT CONTRACTOR	1840	DØ F3	BNE 1834	100 IF YC>256THEN 50
OPERAND A9 00 85 FE 85 FF E6 FF D0 FC E6 FE D0 F6 60	MNEMONIC LDA #0 STA FE STA FF INC FF BNE FC INC FE BNE F6 RTS	BASIC EQUIVALENT 10 A=0' 20 POKE254,A 30 POKE255,A 40 POKE255,PEEK(255+1) 50 IFPEEK(255)(>0THEN40 60 POKE254,(PEEK(254)+1) 70 PEEK(254)<70THEN30 80 RETURN	1842 1843 1845 1847 1849 1848 184B 184B 184F 1851	60 89 80 85 FE 85 FF E6 FF D0 FC E6 FE D0 F6	RTS LDR #0 STA FE STA FF INC FF BNE 1848 INC FE BNE 1847 RTS	110 END 120 REM 130 REM 140 REM 150 REM 160 REM 170 REM 130 REM 130 REM

Space Invader games have a running total of the number of bullets on the screen at a time. To do this in Basic, we would have something to the tune of

FORA = OTON : POKEA, X : NEXT

Notice the use of A as an address which varies. This is an indirect Poke; load X into the byte whose address is stored in the variable A; to convert this into machine code it would be best then to use an indirect command preor post-indexed with either X or Y respectively.

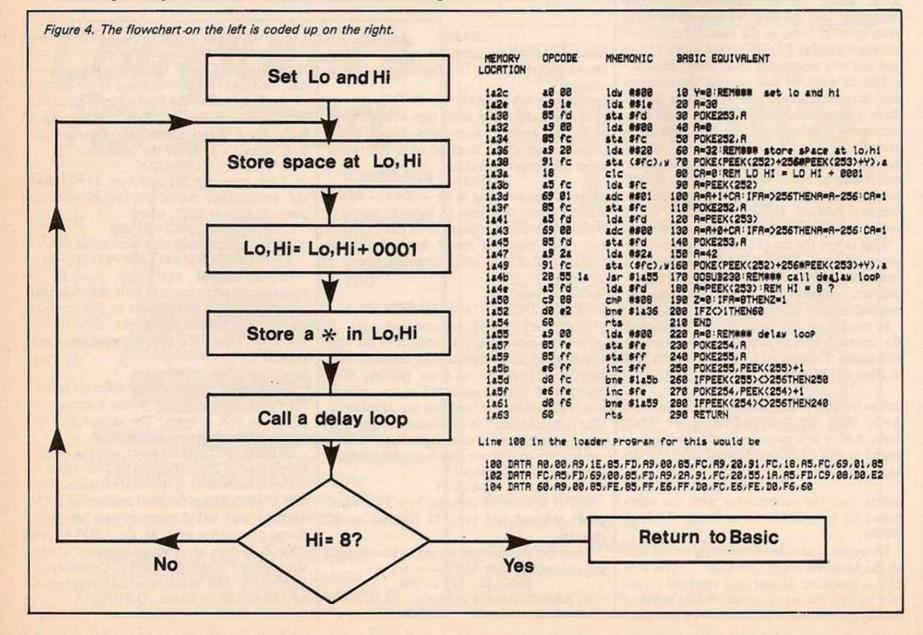
Try moving a character across and down the screen on a Vic. The screen is larger than 256 bytes so we are going to have to use a Lo-byte Hi-byte system and increment it as we move our * across. But first, advanced adding up should be considered.

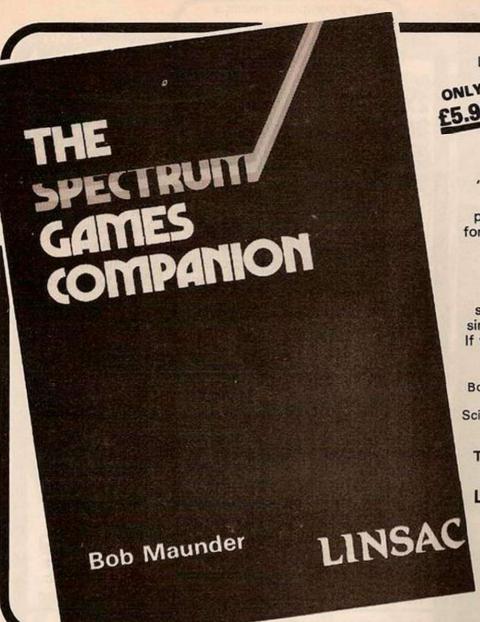
When adding up in two bytes we can still use the ADC — Add with carry — command which can be thought of as

ADC: A = A + (data) + (carry)

Add the data represented in the ADC command to the contents of the accumulator and then add the contents of the carry flag — either 0 or 1.

To add in two bytes we add the Lo-bytes, store them and then add the Hi-bytes. Simple? Not quite. We need some way of telling whether the total of the two Lo-bytes came to more than 255 so that we can either add an extra 255 in the form of incrementing the Hi-byte total or not as the case may be. Enter the carry flag. The adding of the carry flag, which at first seemed to be a nuisance now makes sense in that in a two-byte addition, if the sum of Lo-bytes is greater than 255 this is automatically taken care of in the Hi-byte stage thanks to the ADC command adding the carry flag for us. A flowchart can now be translated into machine code.





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Do you GET tired of having to set parameters of a machine-code routine by Poking numerous addresses with the necessary values? If you do, the following machine-code routine is the answer: it makes Poking completely unnecessary.

The problem is avoided by setting up the values using Basic variables and then searching the variables area to find their value and storing them in the spare bytes of the printer buffer.

To demonstrate the technique, I have attached the search program to a routine which prints a message anywhere on the screen using characters of any height or width, in any ink colour.

The x and y variables are used for the start of the message; since these are the co-ordinates of the top-left corner of the first character of the message the usual Spectrum plot positions apply. That is, 0,0 is the bottom left-hand corner of the screen. For the height of the characters, h is used. Normal height is 1, 22 will be full screen. Width of characters is w. Normal width is 1, 32 is full screen for one character.

The string containing the message to be printed will be a\$. The only limitations on the message are that it can only contain characters from code 32 - space - to code 127 copyright - and that the number of characters multiplied by width of character should not exceed 32 with the Plot position at the lefthand edge of screen. If this is exceeded the program will not crash but the message will wrap round the screen overprinting as it goes.

The program is fully mug-trapped and any wrong parameter of x and y will be corrected before plotting the string. The machine code to find the variables x, y, h, w and a\$ is shown in listing 1.

If you read through Chapter 24 of the Sinclair Manual you will see that there are six types of variable, namely: a number whose name is one letter - type (i); a number whose name is two or more letters - type (ii); an array of numbers - type (iii); For-Next loop control - type (iv); string variable - type (v); an array of characters - type (vi).

Each of these variables is uniquely identified by its first byte.

Variable type i = 96d + (letter code - 96d) Variable type ii = 160d + (first letter code - 96d)

(continued on page 137)



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Variable type iii = 128d + (letter code - 96d) Variable type iv = 224d + (letter code - 96d) Variable type v = 64d + (letter code - 96d) Variable type vi = 192d + (letter code - 96d) The variables we will be searching for will be types (i) and (v).

If we take, for example, the variable x which has a character code of 120, then using the formula (i) given, its unique first byte is 120. So in order to find variable x we must search through the variables for this unique code, which will then point to the start of the x variable information. This is not just a simple case of running through the variables one byte at a time using a CPIR instruction, as this may find the code 120 held in a string or an array of characters. So we must find the start of each variable, check if it is the one we want, and if not, then jump to the start of the next variable. This means that we must identify the type of variable found before we know how far to jump to the next one. This is not as difficult a task as it might first appear because of the way in which the Spectrum stores the variable parameters.

With three of the variables, namely array of numbers, array of characters and strings, the length of the variable is held in the two bytes following the unique code byte. What is more helpful, bit 5 of the unique code is zero and the remaining three variables have bit 5 set at

The length of the three remaining variables can be calculated by this method:

Type (i) length = 6 bytes including unique code. Type (ii) length = number of letters of variable + 5 bytes

Type (iv) length = 19 bytes including unique code.

We now have the information to enable us to jump over each type of variable, and the checks must be made in the following order: first, check if code is 120; if yes then return from routine; check bit 5 and if zero jump by

value in next two bytes + 1: GOTO 1 Check bit 6 and if zero check following bytes for

BIT7 = 1

that is the last character of the variable, then jump six bytes and Goto 1. Check bit 7 and if zero then jump 6 bytes and Goto 1. Now it must be a For/Next loop so jump 19 bytes and Goto 1.

The mnemonics of the machine-code program to do this are shown in the Find subroutine. This uses address 23728 to hold the unique code of the variable for which we are searching. The HL register holds the address being checked, and the accumulator is loaded with the unique code from address 23728.

The subroutine only takes 46 bytes to check, Jump and locate the start address of any variable.

Now that we have found the start address of our variable x we must find its value. You will see that the value for whole numbers is held in the third and fourth bytes following the unique code. In our case we are only interested in numbers from 0 to 255 for x. So we can ignore the high byte and store the low byte, that is the third byte. This applies to all our variables x, y, h and w.

With this in mind a subroutine, Setup, can

be assembled to move along three bytes from the address held in HL and then store the value held in this address in the printer buffer area of memory. So we now have the means of finding and storing values of x, y, h and w in addresses 23296/7/8 and 9.

We can now move to the slightly more complicated string parameters. In our case we need to find a\$, unique code 65. The same Find routine can be used to find the start of the variable. Once found we then move to the next two bytes to find the LEN of the string as

> INC HL LD E.(HL) INC HL LD D,(HL)

This will put the length of the string into the DE register, and, as we can safely limit the length of the string to 255 characters we only need to store the number in low byte:

LD (23300), DE

The number in address 23301 will be overwritten with the first character in the string:

PUSH DE Get number of characters into

POP BC

INC Set HI at start of characters HI

LD DE,23301

LDIR Transfer information

The above will transfer the string characters from the variables to the printer buffer starting at address 23301.

With this routine we now have x, y, h, w, length of string, and characters in string stored consecutively in the printer buffer, and can go straight into the routine to plot the string based on these parameters.

The plot routine finds the start of the eight bytes for each character in the character set and, for each byte, a Rotate Left instruction is carried out either plotting or unplotting depending whether Carry is set or not. Again use is made of the two unused bytes in the Systems Variables 23728/9 to hold and update the x,y plot positions for each character.

If the y plot position goes below zero, then it is reset to 175 to give a wrap around effect and likewise if the x position goes above 255 it is reset to zero. So now we have a machine-code program that can be called from Basic with no Pokes in sight - for example:

10 LET x = 0 : LET y = 100 : LET h = 8 : LET w = 4 : LET a\$ = "Finished" : INK 6 : RANDOMISE USR 32393

This saves 13 Pokes including LEN a\$. Listing 1 shows the Basic program to set up the machine code above RAMtop. On a 16K Spectrum this is immediately before the userdefined graphics and occupies 255 bytes. Once the machine-code is entered the Basic can be Newed and the code saved in the usual way.

There are a couple of points to watch with this program. First, ensure that all the variables are defined before a call is made to the routine as failure to find a variable will crash the program. Second, Do not use x, y, h, or w as a control variable for a For-Next loop because the Spectrum will then delete the simple variable and use the For-Next loop to hold further values of x, y, h and w. This can be demonstrated by the simple Basic program:

10 FOR a = 1 TO 10 20 PRINT a;

30 NEXT a 40 LET a = 3 50 NEXT a

This program will produce a continuous loop resetting a to 3 and jumping back into the For-Next loop showing that the variable - a - in line 40 is part of the For-Next loop control variable. If this was not the case the Spectrum would give an error report:

1 NEXT without FOR, 50:1

You can have a small Basic subroutine to work out the width of characters and the start plot position to give information printed centrally on any line; such a program is given in listing 2 with sample printout.

We can now also tackle a machine-code program to print out all the variables used after a program has been Run. Note that this may not be all the variables in the listing as when a program is Run certain subroutines may not have been called and so variables held in those routines will not have been placed into the variables area.

This program — listing 3 — could be of use in debugging Basic programs. Listing 3 is in the form of a machine-code dump which should be held in Data statements as listing 1, and Poked into a memory position of your choice. There are no Jump or Call commands to within the program. I find it handy to have two versions of the program one stored above RAMtop and another in a line 1 Rem statement containing 311 zeros and called

RANDOMISE USR 23760

The machine-code is then held in the Basic area of RAM and can be Merged with any program — as long as the program does not have a line 1, which will be overwritten. One point to note when Saving the Basic Rem statement on tape is to use Clear to erase all variables used in the machine-code loader, otherwise these will be saved and Merged along with the Rem statement. This is good practice on any program which does not require the variables to be saved.

Listing 4 is a demonstration program setting up variables, and shows a screen copy of the machine-code output which lists these variables under their variable types. Notice how the Spectrum converts all variables to lower case and also that variables a, h, l, o, w, x and z have been listed under the For-Next loop only and not under number.

Listing 5 shows the machine-code mnemonics for assembly into a Rem statement, for anyone who wishes to check through the program to see how it works. The first section from address 5CD0 to 5CE5 sets up the Border, Paper and Ink colours; from 5CE6 to 5D46 prints the heading. The remainder of the program checks the variables one by one finding the type of variable, locating the next Print position in that variables column, updating the Print position and printing the variable.

The section from 5D94 to 5DBE is interesting in that it checks for a column reaching the bottom of the screen and if it does then waits for a key press before scrolling 21 lines," leaving the heading on the screen and printing the next variable in position. A return to Basic is only made when all the variables have been listed.

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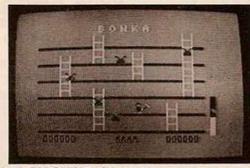
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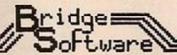
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```
(continued from page 137)
                                                                            Routine to plot the string
                                                                                                               HL, (23296)
R, H
176
C; YES
H, R
(23296), HL
(23728), HL
HL, 23301
                                                                                               XOR
Start address for 16K machine code 32235.
                                                                                                                                                     END
                                                                                                                                                                        POP
                                                                                                                                                                                        AF
                                                                                                                                                                                       Hr
BC
LOOP2
A, (23296)
HL,23728
(HL),A
ORG 32335
                                                                                                                                                                        DUNZ
Subroutine to find variables.
                                                                                                SBC
JR
LD
                                   HL, (23627)
A, (23728)
(HL)
Z
                   110
                                                                                               LD
                                                                                                                                                                        INC
                                                                                                                                                                                        HL
                   RET
                                                                            YES
                                   5, (HL)
NZ, NEXT
                   BIT
                                                                                                                                                                        XOR
                                                                                                                                                                                        A, (HL)
176
C,OK
(HL),A
                   UR
                                                                            RUN1
                                                                                                PUSH HL
                                                                                                                                                                        LD
                                                                                                              HL
A, (HL)
H, 0
L,A
HL,HL
HL,HL
DE, 15368
HL,DE
B,6
BC
BC. (23297
                   INC
                                   HL
E, (HL)
HL
                                                                                               100
                                                                                                                                                                        SBC
                                                                                                                                                                        JR
                    INC
                                                                                                                                                                        LD
                                   HL DE
                                                                                                                                                                        JRDD
                   LD
                                                                                                ADD
                                                                                                                                                                                        A, (HL)
                    ADD
                                                                                                                                                     OK
                                                                                                ADD
                                   HL
                    INC
                                                                                                ADD
                                                                                                                                                                                        NZ,0K1
(HL),176
(HL)
                    JR
                                                                                                                                                                        JR
                                                                                                I D
                   BIT
NEXT
                                   6. (HL)
NZ, NEXT1
                                                                                                ADD
                                                                                                                                                                        LD
                                                                                              LD BC, (23297)
LD A, (HL)
PUSH HL
PUSH BC
LD B
                                                                                                                                                                        DEC
POP
POP
DUNZ
                                  NZ,NEXT:
HL A, (HL)
7,A
Z,LOOPS
DE, 6
HL,DE
START
7,LOOPS
DE,19
HL,DE
START
                                                                                                                                                     OKI
                   INC
LODPS
                                                                            LODP4
                                                                                                                                                     CONT
                                                                                                                                                                                        BC
                   LD
                                                                            LOOPS LD
                                                                                                                                                                                        HL
                   BIT
                                                                                                                                                                                        LOOP3
                                                                                                                                                                        INC
POP
DUNZ
LD
ADD
                   JR
                                                                                                                                                                                        HL
LOOP6
                                                                                               PUSH BC
RLA
                   ADD
                                                                                                                                                                                        LOOP4
                                                                            LCOP2
                                                                                                                                                                                        A, (23299)
A
                    JR
                   BIT
NEXT1
                   JR
                                                                                                PUSH AF
                                                                                                                                                                        ADD
                                                                                                                C,PLOT
HL,(23299)
A,(23728)
                                                                                               UP
                   LD
                                                                                                                                                                        ADD
                   ADD
                                                                                                                                                                        LD
                                                                                                LD
                                                                                                                                                                                        A, (23728)
                                                                                                                                                                        ADD
                                                                                                ADD
                                                                                                                                                                       200000
                                                                                                                                                                                        (23296),A
(23728),A
A,(23297)
(23729),A
HL
                                                                                               LDP L
                                                                                                                 (23728) ,A
 Subroutine to set parameters
                                                                                                                END
                                                                                                                BC, (23298)
                                                                            PLOT
 of variable to be found.
                                                                                               PUSH BC (23728)
PUSH BC
                                     (23728) .A
                    CALL HERES
                                                                                                                                                                        INC
                                                                                                                                                                                        HL
                                                                                               CALL
                                                                                                                22E5H
                                                                                                                                                                                        A, (23300)
                                                                                                                                                                        DEC
                                                                                                                BC
                                   A, (HL)
(BC),A
                    INC
                                                                                               INC
                                                                                                                                                                        RET
                                                                                                                                                                        LD
                                                                                                                                                                                         (23300) ,A
                    LD
                                                                                                                 (23728) ,BC
                    LD
                                                                                                POP
                                                                                                                BC
                                                                                                                                                                                        RUN1
                    RET
                                                                                               DUNZ LOOP1
                                                                                                                  Example program - listing 2.
                                                                                                                  10 LET x=0: LET y=175
20 LET h=4
25 FOR (=1 TO 5
30 READ a$
40 LET w=INT (32/LEN a$)
50 LET x=INT ((256-(8***LEN a$
))/2)
60 RANDOMIZE USR 32393
70 LET y=y-8*h
80 NEXT (
85 LET y=y+24
86 READ a$: RANDOMIZE USR 3239
3: STOP
 Start of machine-code routine.
                               BC,23296
A,120
               LD
STRIE
                                                          CALL CONTROL INC HL
                                                                           (23728),A
                LD
               CALL BEARS
                                                                         E, (HL)
HL
D, (HL)
(23300),DE
                                                          LD
                CALL
                               BC
A, 104
                                                          INC
                INC
                                                          PUSH DE POP BC
                CALL
                               5C
A,119
                                                                          BC
                INC
                                                                                                                  LD
                                                                          DE,23301
                CALL
                                                          LDIR
                                                                                                                ,17,5,91,237,176,42,0,91,175,124
,222,176,56,4,103,34,0
120 DATA 91,34,175,92,35,5,91,2
29,126,38,0,111,41,41,41,17,0,60
,25,6,6,197,237,75
130 DATA 1,91,126,229,197,6,8,1
97,23,245,218,249,126,42,3,91
140 DATA 58,176,92,133,50,176,9
2,195,15,127,237,75,2,91,197,237
,75,176,92,197,205,229,34,193
150 DATA 12,237,67,176,92,193,1
6,238,241,193,16,211,58,6,91,33,
176,92,119,35,175,126,222,176
160 DATA 56,3,119,24,8,126,254,
0,32,2,54,176,53,193,225,16,177,35,193,16,168,58,3,91,135,135,13
5,111,58,176,92,133
170 DATA 56,0,91,50,176,92,58,1
,91,50,177,92,225,35,58,4,91,61,
200,50,4,91,195,206,126
200 LET x=0: LET y=100: LET h=8
: LET y=4: LET ay="Finished"
210 RANDOMIZE USR 32393
220 STOP
9999 SAUE "large" LINE 1
(continued on page 142)
 1 REM x=x axis
2 REM y=y axis
3 REH h=height
4 REM v=width
5 REM a$=message
10 CLEAR 32334
20 LET start=32335
30 FOR a=start TO 32599
40 READ code
50 POKE a,code
60 NEXT a
70 DATA 42,75,92,58,176,92,190
200,203,110,32,8,35,94,35,86,25
35,24,239,203,118,32,12
80 DATA 35,126,203,127,40,250,
17,60,25,24,223,203,126,40,246,
17,19,0,25,24,213,50,176
90 DATA 92,205,79,126,35,35,35,126,2,201,1,0,91,62,120,205,125
100 DATA 3,62,104,205,125,126
100 DATA 3,62,104,205,125,126,3
,62,119,205,125,126,62,65,50,176
,92,205,79,126,35,94,35,86
110 DATA 237,83,4,91,213,193,35
  Listing 1.
```

(continued on page 142)



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Following in the footsteps of our extremely popular original interface, which has sold over 1,000 worldwide since October last year, we have improved its performance.

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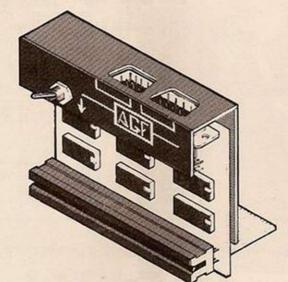
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- * Rear extension connector for all other add-ons
- * Free demo program, 'Video Graffiti' + full instructions



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	SOFTWARE AS TICKED ON LIST		
ZX81 🗆	ZX SPECTRUM Please tick	FINAL TOTAL	

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```
(continued from page 140)
                                                                                                                                                                                    FOR a=1 TO 2: NEXT a

OIM b (7)

LET b (8=1)

LET detai (8=1)

LET detai (8=1)

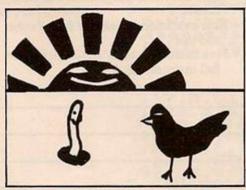
LET detai (8=1)

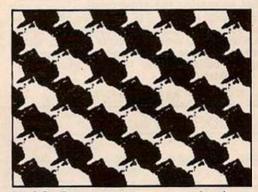
LET b=1

LET b
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     Listing 3.
Listing 4. 123
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        5098
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             Z,5098
DE
DE
DE
SD98
SD62
(5898),DE
A,(DE)
15
NZ,508F
                                                                                                                                                                                                                                                                                                                                                                                              Screen copy of listing 4.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       FNE $ () ESENO. () ENO. E (UORD) NO.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            detaits
define
data
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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         DE HL 90 P. (HL)
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10 P. (HL)
10 P. (HL)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          Listing 5.
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               HATTHEFT HE STREET OF STRE
                                                                                                                                                                                                       RANDOMIZE USR 31900
LPRINT COPY
LPRINT ''"MRCHINE CODE DUM
                                                                                                      S60 LPRINT '"MAY BE LOCATED AN WHERE IN RUALLABLE HEMORY"
570 LPRINT BOOK TO 32210 STEP 8
510 FOR $=31900 TO 32210 STEP 8
510 FOR $=0 TO 7
620 LPRINT TAB $44.PEEK (a+b).
530 NEXT $1 STOP
9995 CLEAR 31599: LORD ""CODE:
G0 TO 1
9999 SAUE "basicyars" LINE 9998:
SAUE "Variables" CODE 31900,312
```

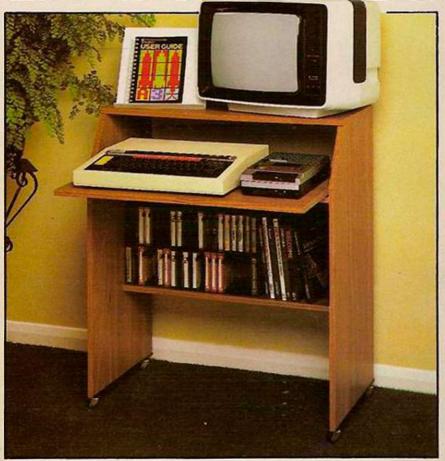
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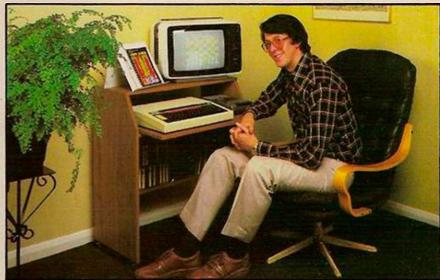
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No matter how fast I fired, the Megapede kept.
on coming! I was gaining ground, though, when suddenly the Spider appeared on collision suddenly the Spider appeared on collision.
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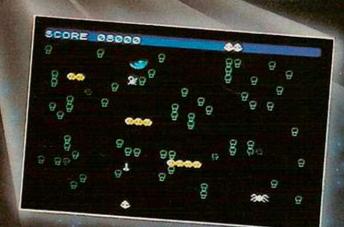
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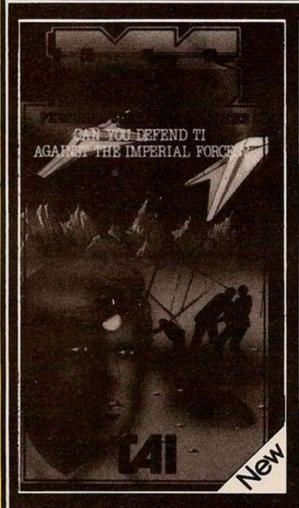
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Arcade Style Games for

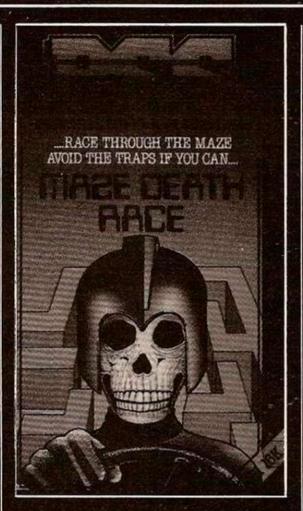


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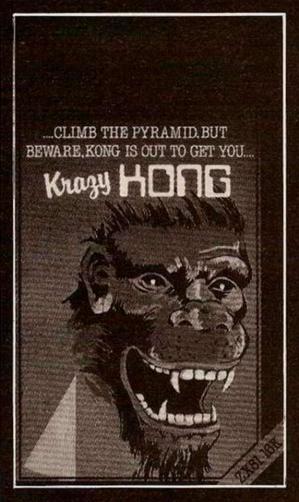


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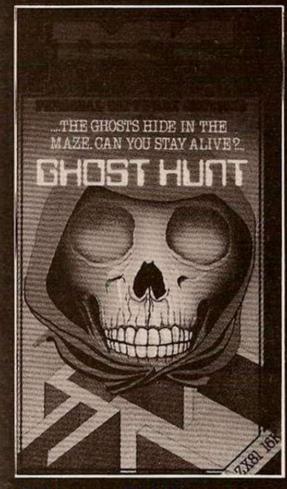
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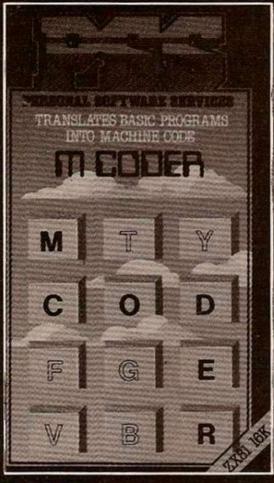


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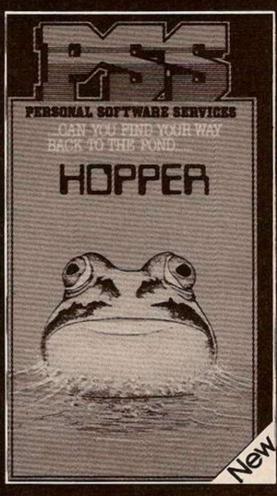




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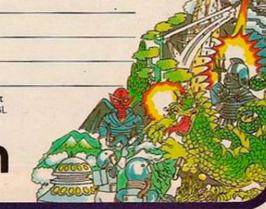
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BASIC DICTIONARY

This dictionary, compiled by Tony Edwards, will explain the function of common Basic words as used in popular machines, enabling you to work out your own machine's equivalent. A useful complement to our recent series on Basic dialect translation.

BASIC DICTIONARY

@ (at) Used as an abbreviation for AT. On some computers

<shift> @

will freeze execution until another key is pressed.

(hash) Used as a flag to indicate double precision variables. The BBC Micro uses the hash sign to indicate an immediate operation in assembler. This sign is also used with the meaning "number" when referring to peripherals. CLOAD # 1

will load from peripheral device number 1. Also used to represent "not equal to"

- \$ (dollar) An ANSI standard symbol indicating string variable. It is often used to indicate string functions also.
- ! (exclamation mark) Used as a flag to indicate single precision variables. Its use is usually optional as variables default to single precision. Some interpreters use the exclamation mark as an abbreviation for Remark.
- % (per cent) A flag used to indicate

integer variables. It is also used in connection with a Print Using statement to indicate the output is unprintable.

- ? (question) A common abbreviation for PRINT.
- / (back slash) An operator used to allow multiple statements on a single line. It is also used as an erase indicator when correcting typing errors.
- (asterisk) An alternative for the multiplication operator. It is also used on some computers as the logical AND operator. The BBC Micro uses it to express the binary multiplication of integers and
- ** (double asterisk) An alternative for the exponentiation operator.

(circumflex) An exponentiation operator

(plus) The arithmetical addition operator. Some computers use this symbol in place of the logical OR so care must be exercised with such statements as "IF (A=0) + (B=0)" which will be satisfied if either A or B is equal to 0.

BASIC DICTION.

This symbol is also used to indicate concatenation of strings.

- (minus) The arithmetic subtraction operator, also used as a negation
- operator.
 (slash) The ANSI standard division operator.
- & (ampersand) Widely used as a suffix to indicate hexadecimal numerals.
- start of a print field indicating that the item is to be printed in hexadecimal.
- £ (pound) Not usually available, but when it occurs it often replaces the \$ and is used in the same way.
- 1 (down arrow) Represents a line feed.
- (right arrow) Moves cursor right.
- (left arrow) Moves cursor left. Also known as "Back arrow".

< shift > ←

Deletes the current line on some machines.

π (pi) A function which returns the value of

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Popular Computing Weekly 19/8/82 - ZX81 Tasword

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ZX81 TASWORD

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Computers do not share a common tongue, because some languages must be task-specific. John Dawson traces their development.

BABEL

HAVING TRACED some of the history of I

HAVING TRACED some of the history of software from the first faltering machine-code steps in Manchester and Cambridge through the development of Fortran and Forth, this month we look at how information may be regarded as an asset to be examined and manipulated in many ways, rather than as data simply to be fed through a program in order to achieve a pre-ordained printout.

Language tree

First, look at figure 1 and you will see the rough historical order in which high-level languages arose and how the "original" high-level languages have bred their offspring. There are hundreds of computer languages and figure 1 shows only a very few of the more common. Fortran was written for solving scientific problems while Cobol — Common Business-Oriented Language — was commissioned by the Department of Defense in the United States for general "commercial" use. Between them, these two languages are probably used in the great majority of the world's professional computing applications.

How can that be so? There are more sophisticated languages available that are easier for the programmer to use and software development has moved on considerably from the late 1950s when they were first made available commercially. Many professional computing personnel still use Cobol as the language of choice on new hardware. Why? The answer is simple - Cobol and Fortran work, they are well-understood and that makes the task of developing a program or a suite of programs far easier than it would be if an untried language was introduced. Additionally, there are large numbers of subroutines and larger segments of programs that can be incorporated into a new piece of software.

The person who taught me anaesthetics said that "a crisis is no time to use a new technique that is unfamiliar. Stick to something ordinary that you understand well". Most software development turns into a crisis at some stage.

At the same time there is no doubt that Fortran is a pretty revolting language to use. "Structured" programming is nearly impossible using Fortran and one of the major advances in the development of programming languages has been the gradual acceptance of the idea that structure makes programs easier to read, hence less prone to error, and, most important, allowing the programmer a less constrained expression of the steps to the solution of the problem. A program built out of a number of modules will be comparatively easy to debug and can be produced by a team of programmers working to some common standards.

Easy debugging

Modules can be built very easily so that there is a single entry point and a single exit. Once again debugging becomes far easier. Forth allows program development by writing and testing the action of discrete words — modularity carried to a useful and logical conclusion. The Goto instruction, a natural development of the first machine-code

programs which would go to one instruction or another depending on the result of a test, permits crossed lines of flow in a program, several entry points into a block of code and many exits. The Goto or Jump instruction is intuitively attractive and potentially highly confusing.

Many modern languages have no Goto instructions relying instead on loops controlled by Do — Until or Repeat — While operations to create structure in the program.

Computer languages can be classified in a number of ways. There are fine differences between some versions of a language and, like human speech, there are the identifiable characteristics that allow some languages to be grouped into families. After the loose "commercial" versus "scientific" distinction epitomised by Fortran and Cobol, there is a split between interactive and batch-processing languages. An interactive computer language provides facilities that allow the programmer to make changes in the program almost as it is executing. The ordinary interpreted Basic supplied with almost every microcomputer is an interactive language. A batch-processing language makes no provision for the operator to modify the program at the computer.

I remember going to a hut behind University College in the late 1960s, sitting at a large card punch to produce a set of cards holding a Fortran program and then handing the cards across a counter in the computer department. The cards also made splendidly original party invitations with a small line of type at the top and coded holes all over the rest of the card. However, it was 24 hours later before I was able to return to collect the results of my program execution.

Fortran has now been implemented, that is installed and made to work on a number of microcomputers and has become more interactive. It is still a compiled language, which means that you must first write the source code, then compile that to object code — machine-code instructions that will execute on your machine — and finally you can run the object code to carry out the operations you wish. If an error occurs you must load the source code back into your computer, find and correct the error and start the process all over again.

Functional languages

Lisp and Prolog are examples of a group of computer languages which are known as functional languages. The other languages shown in figure 1 are "imperative" languages. A program written in an imperative language is composed of a series of statements which are obeyed by the computer. Certainly the machine may choose one of two or more conditional branches from time to time but the program is carefully prepared to take account of those possibilities. In other words, the programmer must describe quite precisely how a result is to be computed, rather than concentrating on the result itself. Functional languages work fundamentally by evluating a function and the general form of a program is:

Results = Function (input values)
For example, a question in Prolog is a program. At a very simple level a Prolog programmer might write:

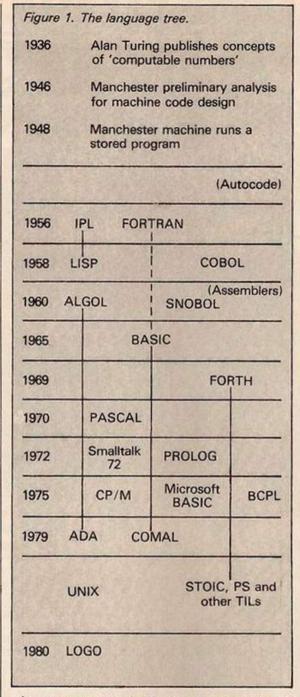
Which (x x sex Male and x illness Glandular Fever)

which might produce this on the screen of the computer:

Answer is (Bertram Leadston) Answer is (John Salmon) Answer is (Nigel Mudthorpe) No (more) answers

if the information had been entered, probably among a lot of other data, under the headings of "name", "sex" and "illness". In relation to the general form of the program. 'Which' is the function to be carried out and the items in the brackets are the input values.

Snobol is an example of a Markov language: that is a language in which the basic operation is to look for a pattern, substitute something in its place and choose the next statement to be carried out on the basis of the match between



the two patterns. A Markov statement is said to be a random process in which the probability of a transition to a new state depends only on the current state. D W Barron says in An Introduction to the Study of Programming Languages that it is arguable that all algorithms — the sequence of operations necessary to solve a problem — can be reduced ultimately to Markov statements. Snobol 4 is a versatile string-processing language which can be used for text manipulation. You could, for example, look for a match in Snobol by typing the following statements:

STRING "John Dawson" : S (PRINTOUT) F (TRYAGAIN)

Data protection

If the words "John Dawson" appear in the characters which make up String — a Successful match — the program will branch to the label Printout. If the match Fails — F — then control will pass to the section of the program labelled Tryagain. There are many other sophisticated search and manipulation instructions in this language and Snobol may be one of the computer languages which could be used in computer applications that particularly worried the Lindop Committee on Data Protection because of the possibility of free text retrieval from very large computer files held about individuals.

The fourth loose distinction between types of computer languages differentiates between ordinary programs such as Basic and Pascal, and real-time computer languages for controlling a process as it occurs.

The hallmark of a real-time language is its ability to respond to external interruptions as peripheral devices generate information that must be taken into consideration by the program.

Because "bit-twiddling" and interrupt handling are difficult to achieve at a high level, most real-time languages tend to work in an intimate relationship with the machine's operating system. Forth, Stoic and the other Threaded Interpretative Languages are able to drop directly into low-level, and hence fast and finely controllable, assembly language which indicates that it should be simpler to try to create a real-time program in Forth than in Basic, Pascal or Fortran.

An aircraft simulator is a good example of an application that may require real-time computing, taking in the responses made by the pilot through the cockpit controls, processing that information, and then changing the attitude, speed and other simulator outputs to match the real aircraft's characteristics.

Sieve race

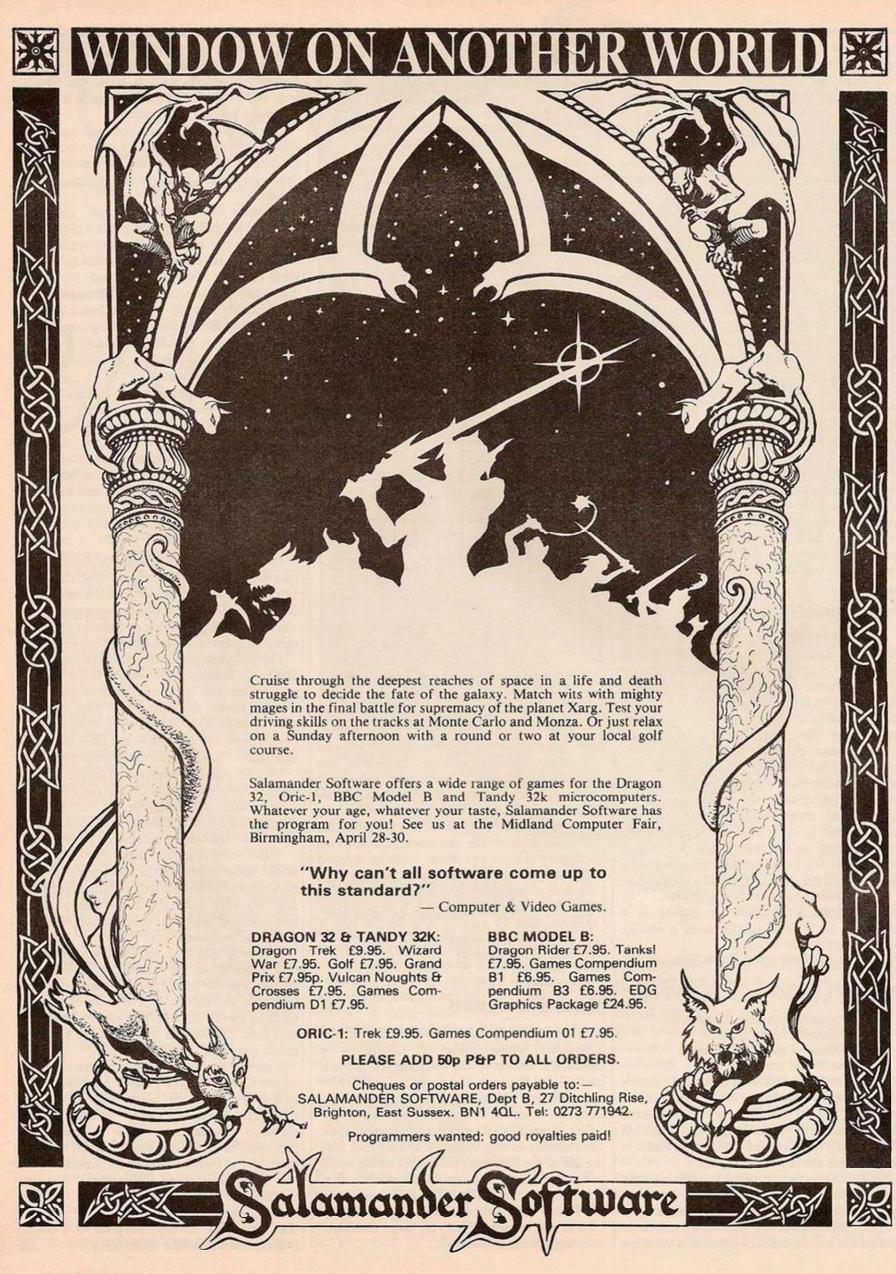
After all the esoteric discussion about which language suits which purpose best there are some simple stark facts based on the results of a January 1983 survey in which the same program was run on a large number of different machines using different languages on different machines.

The program was a standard version of the Sieve of Erastothenes which finds all the prime numbers between 3 and 16,381. The world's fastest computer, the Cray 1, vied with an IBM 3033 for the shortest time using Fortran — 0.110 seconds — and IBM assembly language — 0.0078 seconds — respectively.

Various microcomputers competed for the slowest time which was finally achieved by a Xerox 820 operating under CP/M and programmed in RMCobol. This combination took 5740 seconds to complete the same task—a difference of approximately 700,000 times in the speed of execution. Remember that the performance of a machine on a single program may say very little about the utility of the machine and language combination for your particular purposes.

However, that said, the fascinating statistic that I found in the listing of performance figures was for the Apple II computer programmed in Fortran. One version of Fortran running on the original 6502 central processor unit took 333 seconds to find all the expected prime numbers.

A second version of Fortran which operated under CP/M using a plug-in Microsoft card took only 34 seconds, about one tenth of the time. That difference cannot be explained by variation in the clock rates allowing one processor to run faster than another, nor can the physical construction of the machine play any significant part. The only possible explanation is that the version of Fortran running under CP/M is vastly more efficient than the other for this purpose — a better implementation of the language.



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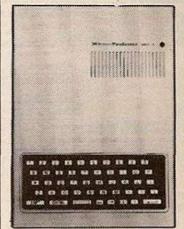
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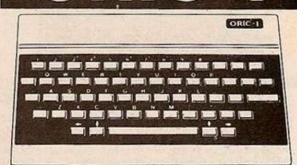


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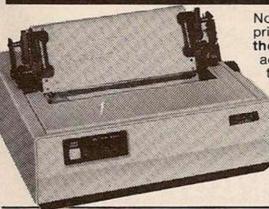
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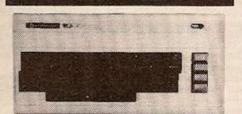
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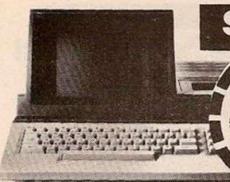
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158 YOUR COMPUTER, MAY 1983

RESPONSE FRAME

Do you have a problem? Your manual is incomprehensible or you just cannot get the hang of that programming trick you tried whatever it is, Tim Hartnell will do his best to answer your queries. Please include only one question per letter and mark them "Response

ACE MEMORY

■I have recently bought a Jupiter Ace. I find the 3K on board rather restrictive. What is the easiest way to expand the memory, and what size can I go up to?

Donald Towlinson, Bristol.

A 16K RAMPACK for the Ace is available from Stonechip Electronics, Unit 9, The Brook Industrial Estate, Deadbrook Lane, Aldershot, Hampshire. The company told me that although it is supplied as a 16K unit, it can be expanded — using chips available from them — to 32K. The extra 16K costs £19.95. You can get more details by calling the company on 0252-318260. If you want to discuss your computer with other Ace owners, you might like to get in touch with the users' club. Send a stamped, addressed envelope to Remsoft, 18 George Street, Brighton, BN2 1RH.

BOARD GAMES

■My particular computer interest is in playing board games but I would like to enlarge the normal miniscule playing board from eight by eight to 24 by 24. I gather that this can easily be done on the ZX-81 by Poking into the variable which controls the bottom half of the screen. If, however, I Poke 23659 with zero on the Spectrum I get a blank screen, remedied by altering the Border colour, but the computer then locks up. Is there a solution?

D G Daverson Brentzpood.

THERE ARE two ways around this. Either use Print hash, or change your board size to 16 by 16. This allows you to have each square on the board occupying four character cells, and some pretty elaborate pieces can be created with userdefined graphics to fit within the 16 by 16 matrix.

MISSILE GAP

■I own an Atari 400 computer. Knowing that you have one, I decided to enquire about some things which I do not understand. I have been told that there are player-missile graphics but none of the numerous books and papers which I got with the computer signified what player-missile

graphics are, or how they can be operated. Can you enlighten me? I would also like to know how one can use the userdefinable graphics characters.

Thomas Martin. Kerridge, Macclesfield.

PAUL BUNN, in his book Making the Most of Your Atari, explains that there are four players and four missiles on the computer, each with its own colour register, size register and horizontal position register. A player is exactly eight bits wide by either 128 - double - or 256 single-line resolution. To create your player, you plot the squares on a grid which is eight by whatever height you want the player to be. You then put the numbers 128, 64, 32, 16, 8, 4, 2 and 1 above the grid, adding the value if the square for the shape is

ORIC NOTICE

■I am thinking of buying an Oric computer. I will be using it, among other things, as a kind of electronic bulletin board for a club I belong to. I have seen that you can get tall letters on the BBC Micro. Is it possible to do the same with the Oric? I cannot afford a BBC machine, and have heard that the Oric would be a good second choice.

Patrick Shepson, Leighton Buzzard.

THE ORIC has a number of commands - including the colour ones, of course - to enable you to dress up your text output. You can get double-height characters by using Control D. If you want double-height characters, you enter as part of the program PRINT CHR\$(4);CHR\$(27);"J

...followed by text"

The J will not be printed. Change the J to an N to get double-height, flashing characters.

WORD PROCESS

I am a newcomer to microcomputers and with Your Computer and a subscription to some books, have been trying to learn more about the mountain of hardware and software available. I want to be able to do word processing but it seems that as printers go from 80 characters upwards, to have a microcomputer displaying 32 characters is not the best way of doing it. To have to scroll a 32character screen left to right does not seem ideal. As I am an compile financial software. But I feel that disc drives will make some computers I am considering, such as the NewBrain, too expensive. The Spectrum for the price seems excellent, especially with the Microdrive. Could you give me an assessment of the home-study Basic course offered by the NCC. Is it of any use to a beginner?

> B J Owen, Rivadh, Saudi Arabia.

A BBC MICRO with word processor ROM would solve your word processing problems, but you would have to check that a suitable accountancy package is available; and also whether you can afford to add discs to the BBC machine when you get it. The NCC course has sold extremely well. While not the breeziest presentation of the subject matter available, it covers the field very competently and carefully. It is one of the best overall introductions to Basic available at the moment.

INCOMPATIBILITY

I am still waiting for my Spectrum to be delivered. I do not know much about the machine code. I would like to know if I can use the ZX-81 machine-code articles featured in the past in Your Computer, and if not, what modifications would be needed to get them to work.

> Farid Ehsan. Portswood,

UNFORTUNATELY, the short answer is "No". Most machine-code programs put material on to the screen, and the routines to do this need to be totally rewritten for the Spectrum.

DRAGON DAZE

I have seen a great deal of software advertised for the Dragon 32. I have only had my Dragon for a month, and am quite bewildered as to which is the best software to buy. I am mainly interested in arcade games. Can you advise me?

> Gwyn Parkly, Paisley, Renfrewshire.

THE SCOTTISH Dragon Club, Walker Street, Edinburgh may well be able to help you with information on commercial software. Suppliers of Dragon software include APG. Software, 24 Mountain View, Peel, Isle of Man; Stanley Software, 91 Cradley, Widnes, Cheshire; Saint George Software, 73 Ling Street, Liverpool, L7; DACC, 23 Waverley Road, Hindley, Greater Manchester, WN2 3BN; Juniper Computing, 8 Pembroke Green, Lea, Malmesbury, Wiltshire SN16 9PB; and Wizard Software, PO Box 23, Dunfermline, Fife, KY11 5RW. There are also a number of Dragon books around including Dragon Load and Go, Making the Most of Your Dragon 32, Enter the Dragon and Dynamic Games for the Dragon 32. See also last month's review of Dragon software in Your Computer.

DRAGON LORE

I have recently bought a Dragon 32 computer and would like to know if you could recommend a book on programming in extended Basic. Also, could you tell me which other computer software is compatible with the Dragon?

> Mrs J Begg, Abergavenny, Gwent.

THERE ARE two books on programming in Tandy Color Computer Basic available from Tandy dealers. Although these books deal with the Tandy Color Computer, they apply to the Dragon as the two computers appear to have virtually identical ROMs. Because of this, Tandy Color Computer programs will run on the Dragon 32, if you manage to buy the software on cassette. As well as the books sold by Tandy, there are several other books on programming the Tandy Color Computer available in the U.K. which should prove of use. You will probably find them advertised in this issue of Your Computer.

ROM SWEET ROM

Reading the BBC Microcomputer literature, I see that "up to four different 16K interpreters" may be fitted inside the machine, and that the Basic interpreter supplied is classed as one of these. Are the other language ROMs - Pascal, Forth and Lisp - available yet? Is the mnemonic assembler part of the Basic ROM or is it part of the 16K machine's operating system, and therefore able to be accessed by the other language ROMs. Will it be possible to buy the Micro fitted with one of the other languages as standard instead of the Basic interpreter being sup-

M E Needham Clitheroe, Lancashire.

THE OTHER language ROMs are being developed in order, with the Pascal one first. The assembler is part of the Basic ROM, and therefore cannot be accessed by the other language ROMs. However, it is possible that the other ROMs may include assemblers. Acorn tells me it has no plans to release the computer with any onboard language, as the initial choice, except Basic.

THE DRAGON DUNGEON

TAKE INVENTORY!

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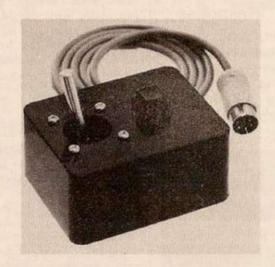
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'Textstar', which stores six pages of A4 per loading, now in stock (£12.95)

Send for current listings.



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DRAGON'S TEETH

The Dragon Owner's Club monthly newsletter is packed with news, reviews and information for the dedicated Dragon-basher. The Dungeon Master is collecting all your tips, discoveries, reviews and "beefs" and will send out guidelines and payment rates to those of you

who feel like breaking into print!
'Dragon's Teeth', which is published in the last week of every month, includes hardware and software offers, Club members adverts and local Dragon user-group news. Badges, T-shirts, Dragon sweaters and similar for extrovert owners!

Annual Membership (including 'Dragon's Teeth') £6.00 six-month trial subscription £3.25.

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Millipede

Shingo Sugiura, Putney, London.



YOU MUST guide a hungry baby millipede gobbling up red fruits whilst avoiding the deadly rocks. Naturally, if you guide him backwards he will bite himself and die. Every time he eats a fruit he grows by one segment. When it reaches a length of 40 segments, you will have to guide another faster baby millipede on a new screen.

You have 3 lives at your disposal. The score is constantly updated and because all the calculations and the printing of the millipede's segments are done in machine code, the action press Escape, this will revert you back to the instructions without clearing the high score. Use Z & X for left and right respectively, and the colon and oblique stroke for up and down.

Lines 50 to 240 machine code Lines 250 to 330 sets up screen Lines 340 to 500 main program Lines 520 to 700 initialise variables Lines 710 to 900 instructions Lines 910 to 1030 sets up screen Lines 1040 to 1090 prints the rocks Lines 1110 to 1200 prints the fruits Lines 1210 to 1240 prints score and high score Lines 1250 to 1280 new screen procedure Lines 1290 to 1310 checks the colour in front of head Lines 1320 to 1360 death procedure

Lines 1370 to 1390 ending procedure is very fast. If you want to change your speed Lines 1400 to 1420 delay procedure

```
ON ERROR GOTO 30
h1%=50
MODE7:PROCINST
HIMEM=$2800:OSWRCH=&FFEE:LGTH%=&70:HEAD%=&71
FOR 1%=8 TO 2 STEP 2:P%=&2800
EOPT1%
LDY #40
.LOOP
LDA &2C1F,Y
STA &2C20,Y
LDA &2C51,Y
STA &2C52,Y
DEY
BNE LOOP
LDY (LGTH%)
.ANI
LDA #31:JSR OSWRCH
LDA #225:JSR OSWRCH
LDA #225:JSR OSWRCH
DEY
BNE ANI
LDA #31:JSR OSWRCH LDA &2C52,Y:JSR OSWRCH
DEY
BNE ANI
LDA #31:JSR OSWRCH LDA &2C20:JSR OSWRCH:LDA &2C52:JSR OSWRCH
LDA #31:JSR OSWRCH LDA &2C20:JSR OSWRCH:LDA &2C52:JSR OSWRCH
LDA #31:JSR OSWRCH LDA &2C20:JSR OSWRCH:LDA &2C52:JSR OSWRCH
RTS:JNEXT IX
         10 ON ERROR GOTO 30
20 hix=50
30 MODE7:PROCINST
40 HIMEM=82800:OSWRCH=8FFEE:LGTHX=870:HEADX=8.71
50 FOR 1%=0 TO 2 STEP 2:PX=82800
60 LOPT18
70 LDY #40
80 .LOOP
90 LDR &2C1F,Y
100 STA 82C20.Y
110 LDR &2C51;Y
120 STA 82C52,Y
130 DEY
140 BNE LOOP
150 LDY (LGTHX)
160 .ANI
170 LDA #31:JSR OSWRCH
180 LDA #32:JSR OSWRCH
180 LDA #31:JSR OSWRCH
180 LDA #31:JSR OSWRCH
190 SOF #31:JSR OSWRCH
190 SOF #31:JSR OSWRCH
190 SOF #31:JSR OSWRCH
190 HEADX:JSR OSWRCH
190 SOF #31:JSR OSWRCH
190 PROCEDED
191 SOF #31:JSR OSWRCH
190 FROCOMAL
190 FRO
                                                                                                                                                                                                                                                                                                                               PRINT THBC2/287/STRING#C36,CF
FOR WALL=2 TO 27
PRINTTABC2/WALL)CHR#224
PRINTTABC37,WALL)CHR#224
SOUND 6:11,-10,WALL*2+100,2
PROCWAITC50
NEXT WALL
                                                                                                                                                                                                                                                                                                             1818 PRINT TAB(3,38); "Score ";score%;TAB(28,38); "High score ";hi%;
1828 PRINT TAB(3,31); "Lives left ";life%;TAB(28,31); "Screen ";scre
                                                                                                                                                                                                                                                                                                                                        PRINTTAB(RHO(33)+3,RND(24)+2)CHR#230
SOUND0,-15,6,1
                                                                                                                                                                                                                                                                                                            1100

1110 DEFPROCFOOD:COLDUR1

1120 FOR FOOD=1 TO 50

1130 PROCWAIT(100)

1140 SOUND1,-10,RND(200),1

1150 PRINTTABERND(33)+3,RND(24)+2);"*"
                                                                                                                                                                                                                                                                                                            1150 PRINTTHECRND(33)+3,RND(24)+2))"#"
1160 NEXT FOOD
1178 VDU17,0,31,17,15,228,17,1
1180 PRINT TAB(18,15))" Ready !":PROCuait(2000)
1190 PRINT TAB(18,15))"
1200 ENDPROC
                                                                                                                                                                                                                                                                                                            1281
1218 DEFPROChumerics:COLOUR8
1228 IF score%)=hi% THEN hi%=score%
1238 PRINT TRB(9,38);score%;TAB(31,38);hi%
1248 ENDPROC
1241
1258 DEFPROChem_screen
1268 PROCwait(2008)
                                                                                                                                                                                                                                                                                                           1241
1250 DEFPROChew_screen
1250 PROCwait(2000)
1270 screen%=screen%+1:sPeed=sPeed-10:IF sPeed(0 THEN speed=0 CLG
1280 ENDPROC
1281
1290 DEFPROCH
 **********
                                                                                                                                                                                                                                                                                                             1290 DEFPROCCHeck
1390 IF col%=1 THEN score%=score%+1:?LGTH%=(?LGTH%)+1:SOUND1,1,1,3:ENDPROC
1310 IF col%=0 THEN PROCCHESS ENDPROC
 1330 SOUND0,1,50,5
1340 PROCusit(1500)
1350 life%=life%-1:IF life%(0 THEN PROCend
1360 CLG:GOTO270:ENDPROC
                                                                                                                                                                                                                                                                                                                              DEFPROCEND
PRINT"DEAD" PRINT"Press SPACE BAR to replay ":REPEAT UNTIL GET=32
GOT0250:ENDPROC
                                                                                                                                                                                                                                                                                                            1400 DEFPROCHAIT(TX)
1410 FOR Delayx=0 TO TX NEXT DelayX
1420 ENDPROC
  718 DEFPROCINST
728 FRINTTAB(13,1); CHR#(138); CHR#(141)"MILLEPEDE"
```

Surrounded

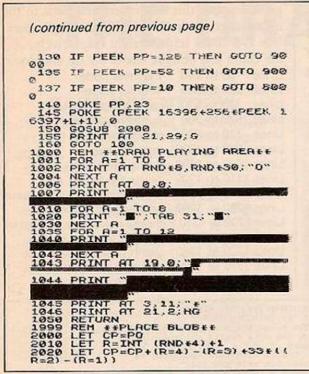
Mark Easton, Mapperley, Nottingham.

333-31

SURROUND IS a novel addictive game for the ZX-81, requiring a good strategic mind. The program takes up just under 4K of memory. The instruction and a sample of the graphics are shown with the listing. In order to make the program easier to understand, Rem statements are included. The program gives a good example of how to Peek and Poke into the display file. Another interesting point is line 2020. This one line replaces:

```
IF R = 4 THEN LET CP = CP + 1
IF R=3 THEN LET CP=CP-1
IF R = 2 THEN LET CP = CP + 33
IF R = 1 THEN LET CP = CP + 33
```

```
1 REM
2 REM
3 LET HG=0
5 GOSUB 9100
10 LET PO=110
20 GOSUB 1000
30 LET Z=6
40 LET G=0
100 LET I$=INKEY$
105 IF I$="" THEN GOTO 100
115 IF (CODE I$) >36 OR (CODE I$)
) <33 THEN GOTO 100
120 LET PO=PO+(I$="5") - (I$="5")
133 **[(I$="6") - (I$="7"))
125 LET G=G+1
127 LET PP=PEEK 16396+256*PEEK
(continued on next page)
                                                                                            (continued on next page)
```



2025 LET PZ=PEEK 16396+256*PEEK
16397+CP+1
2030 IF PEEK PZ=128 THEN GOTO 20
00
2035 IF PEEK PZ=52 THEN GOTO 20
2040 POKE PZ,128
2050 RETURN
2099 REM **EXPAND FRANC**
2100 LET Z=2+1
2102 IF Z>18 THEN LET Z=18
2105 POKE PZ,0
2107 POKE PZ,0
2110 PRINT AT Z,1;"
2115 PRINT TAB 1;"
2120 PRINT AT Z, (RND *28) +1; "O"; A
T Z+1, (RND *28) +1; "O"
2130 RETURN
7999 REM **YOU UIN **
8000 PRINT AT 0,5; "JELL CONE"
8000 PRINT AT 0,5; "JELL CONE"
8000 PRINT AT 0,5; "JELL CONE"
8000 POKE (PEEK 16396+256*PEEK 1
6397+L+1),0
8010 GOTO 9030
8999 REM **YOU ARE DESTROYED**
9040 POKE (PEEK 16396+256*PEEK 1
6397+L+1),0
9010 POKE PP,6
9020 PRINT AT 0,10; "EDESTROYED**
9040 PRINT AT 1,3; "YOU HAVE THE
9045 LET HG=G
9046 PRINT AT 21,2; G
9050 PRINT AT 20,8; "HIT ANY KEY"
9060 PRINT AT 21,2; G
9050 PRINT AT 20,8; "HIT ANY KEY"
9060 PRINT AT 21,2; G
9050 PRINT AT 20,8; "HIT ANY KEY"
9060 PRINT AT 20,8; "HIT ANY KEY"
9060 PRINT AT 20,8; "HIT ANY KEY"
9060 PRINT AT 20,8; "HIT ANY KEY"
90775 CLS
9080 GOTO 10

9100 REH **INSTRUCTIONS*#
9110 PRINT TAB 11; "PURDUND"
9120 PRINT TAB 11; "PURDUND"
9130 PRINT " THE GRME TRKES PL
ACE IN A", "BLACK FRABE CONTAININ
G ABOUT 6, "DEATH PITS "O", UB
CH YOU MUST", "RUGID. YOU PEICE I
S"""
9140 PRINT " HOUSEUR, AFTER YO
UR TURN, THE", "COMPUTER WILL PLACE
E A BLOB """", "IN A VACANT SOU
ARE IN AN ATTEMPTTO SUROUND YOU.
IF YOU HIT A", "BLOB THEN YOU AR
E EUAPOURATED."
9150 PRINT " BUT IF YOU HANAGE
TO MAKE A", "BLOB LAND ON A PIT
YOU WILL SEE", "THAT THE FRAME EX
PANDS. THE ONLYURY TO SURVIVE CE
RTAIN DEATH IS", "TO REACH THE GR
AY LINE, WHICH", "EXPANDING THE FR
AME. BUT DON"T", "EXPANDING THE FR
9160 PRINT AT 21,0;" (HIT ANY KEY
TO CONTINUE)"
9170 IF INKEY\$="" THEN GOTO 9170
9200 PRINT AT 10,1;"
THE ARROWED KEYS
THERE IS NOT SHEET

9210 PRINT AT 21,0;" HIT ANY KEY
9220 IF INKEY\$C"" THEN GOTO 9230
9230 IF INKEY\$C"" THEN GOTO 9230
9230 IF INKEY\$C"" THEN GOTO 9230
9250 RETURN
9998 SAVE "SUROUNG"
9999 RUN

Block blitz

Robert Newton, Wadhurst, Sussex.

SPECTRUM

THIS COMBINES attractive graphics with very interesting sound effects. It is based upon the

Vic-20 game of Blitz and helpfully tells you how many people you massacred if your aircraft runs into too many tower blocks. A high-score routine and variable number of chances have been included to add the competitive nature of the game. If the subroutine at line 7000 is included, then it will start up with some attractive large characters

using the machine-code routine of the Horizon cassette which every Spectrum owner will have. Just run one of the programs on the Horizons cassette and then break the program and type in as a direct command:

SAVE "mc" CODE 32256, 300 to be saved, after the Blitz program on cassette.

```
10 REM
11 RESTORE LET hc=1000 LET
K=0: BORDER 4: FAPER 0: INK 7: C
11 RESTORE : LET ho=1000: LET C: BORDER 4: PAFER 0: INE 7: C

SO REM set up sfaphics 255.255.255

126 24 n=0 To 7

120 FORDER USR "a"+n.a

140 PORE USR "a"+n.a

150 REMD a: PORE USR "b"+n.a

270 READ a: PORE USR "c"+n.a

370 READ a: PORE USR "c"+n.a

370 READ a: PORE USR "d"+n.a

570 READ a: PORE USR "d"+n.a

570 READ a: PORE USR "c"+n.a

570 READ a: PORE USR "c"+n.a

570 READ a: PORE USR "c"+n.a

570 READ a: PORE USR "s"+n.a

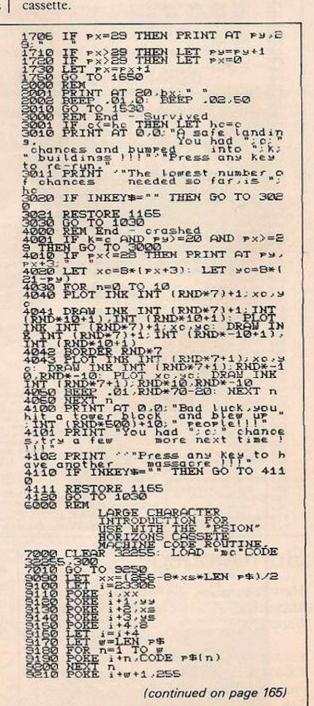
570 READ a: PORE USR "s"+n.a

570 READ a: PORE USR "s"+n.a
                        750 DATA 255,153,255,153,255,15
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3,
          1110 PRINT AT 12.2 "C" AT 12.5 "
```

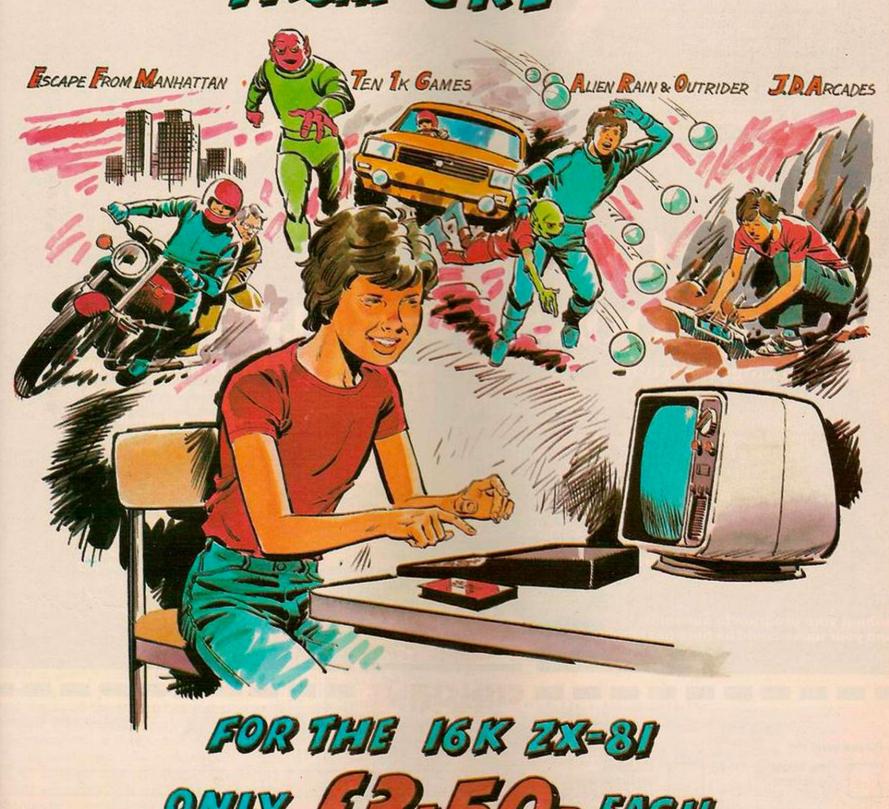
```
### AT 12.16; "B" AT 12.28; "BEE" "

### AT 12.26; "AT 12.28; "BEE" "

### AT 12.26; "AT 11.33; "C" AT 11.43; "C" AT 11.40; "B" AT 12.26; "AT 5.13; "C" AT 5.13; "B 1161; INK 7.5; "AT 8.13; "AT 8.13; "B 1161; INK 7.5; "AT 8.13; "AT 8
```



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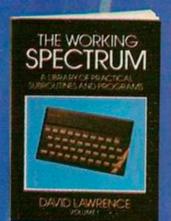


& 2 books from Sunshine

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(228 page book) The first well-documented collection of serious programs for the ZX Spectrum, Programs include a Basic Renumber which can handle Gotos and Gosubs, a character dictionary, a file-handler, several utility programs and a few games. Each program is built up out of re-usable subroutines.

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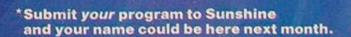


The Working Dragon 32

This is a companion volume to The Working Spectrum and includes several new features such as a Text Editor and a Music Composer and Editor. Other programs help you use the Dragon 32 as an accountant, for more advanced high resolution graphics, as a home tutor for education and for playing games. Each of the programs and subroutines is explained line by line to help develop your own programming skills.

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SEZO LET p\$="@ Robert Newton": L
ETT y=1
SEZO LET xs=2: LET ys=3
SEZO LET xs=6: LET ys
SEZO LET xs=6: LET ys
FLASH Ø: INK Ø: LET p\$="Pre
SEZO FLASH Ø: LET yy=156: GO SUB
SEZO RUN (listing continued from page 162)

Juggler

J Charlesworth, Kings-Lynn, Norfolk.

SPECTRUM

THE OBJECT of this game, for the 16 or 48K ZX Spectrum, is to keep the balls which are bouncing around the screen from hitting the bottom of the screen. To do this, you move a bat back and forth across the bottom of the screen, trying to make the balls land on it so they can rebound upwards.

At first there is just one ball, but every 25 seconds another ball is added and your points, displayed in the top right-hand corner, go up in steps of however many balls there are. All the controls are printed by the computer on running the program.

For speed, I have written all the moving graphics section in machine code. This is stored in the data statements from line 9000 onwards, which the computer will check for errors with a checksum when it is run.

```
BORDER 0: PAPER 0: INK 7
                                      : LET X=10: GO SUB
  200
30 LET a$="": 5 (-x=12: GO SUB
320 GO SUB 500
330 CLS : PRINT AT 0,0;: LET L=
USR 32000
340 LET r=0: LET p=0: GO SUB 40
 0

350 IF INKEY$="h" THEN GO SUB 5

00

360 IF PEEK 23673>=5 THEN GO SU

360 LET P=P+1: PRINT AT 0,27; P

APER 1; P; PAPER 0: LET 1=USR 325

27: IF PEEK 23296(>99 THEN GO TO

350
APER 23222
27: IF PEER 2323
350 390 GO TO 300
390 GO TO 300
400 POKE 23672,0: POKE 23673,0:
LET r=r+(1 AND r(>10): POKE 325
LET; POKE 32575,r: POKE 32578,3
31,r: POKE 32575,r: POKE 32578,3
0-2*r: PRINT AT 0,1; PAPER 1:"RO
```

23,33,0,91,112,35,115,62,22,215,
120
9060 DATA 215,123,215,62,15,215,
62,4,215,62,144,215,261,33,0,91,
63,2,91,134,71,35,94,205,244,126,
254,7,32,10,56,3,91,237,66,50,3,91,
134,95,205,244,126,254,7,56,50,3,91,
134,95,205,244,126,254,7,56,56,5,91,
134,95,205,244,126,254,7,56,56,5,91,136,91,24,12,33,2,91,126,237,68,5
0,2,91,24,12,33,2,91,126,237,68,5
119,35,126,237,66,119,33,0,91,56 ,2,91,134,119,35,58,3,91,134,119
,45,70,35,94,62,22,215,120,215,1
20,215,62,16
9050 DATA 215,62,4,215,62,144,21
5,33,0,1,17,20,0,205,181,3,201
9061 DATA 193,225,6,181,3,201,3,201
9061 DATA 193,225,17,4,0,205,181,3,
225,193,35,16,-10,193,16,-22,6,2
225,193,35,16,-10,193,16,-22,6,2
29,50,0,91,201
9090 CLEAR 31999: LET 3\$="

x=10: GO SUB 200
9095 LET t=0: FOR a=32000 TO 323
42: READ b: LET t=t+b: POKE a, 1
9095 LET t=0: FOR a=32000 TO 323
42: READ b: LET t=0: FOR a=32000 TO 323
42: READ b: LET t=0: FOR a=32000 TO 323
42: READ b: LET t=0: FOR a=32000 TO 323
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42: READ b: LET t=0: FOR a=32000 TO 323
42: READ b: LET t=0: FOR a=32000 TO 323
42: READ b: LET t=0: FOR a=32000 TO 323
42: READ b: LET t=0: FOR a=32000 TO 323
42: READ b: LET t=0: FOR a=0 TO 7: READ b: POKE USR "a"+a,b: NEXT 150
9120 DATA 205,52,120,62,67,160,237,160,2

Sound analysis

Predrag Bogdanovic, Belgrade, Yugoslavia.

233-31

THIS MACHINE-CODE program for the ZX-81 draws graphics illustrating sound. Sound is fed in on the Ear socket. To Load program create a Rem line 45 characters long. Use any hexloader to enter the code. The program is executed by RAND USR 16526. If you want the computer to draw one graphic and then return to Basic type:

POKE 16551.192(N/L)

Sub hunt

Jason Bumford, Hanham, Bristol,

713-30

SUB HUNT runs in an unexpanded Vic-20. It shows a minesweeper on the sea's surface, which moves left and right under machinecode control, while the rest of the Basic program controls submarines passing at random depths and directions. The minesweeper can drop depth charges from the bow and stern and the submarines will randomly retaliate with torpedos. Each sub sunk scores 10 points, and a deliberately wasted depth charge losses two points. A torpedo strike wipes our your score completely. The waste bomb key enables players to detonate depth charges in order to launch another if he has missed. User defined graphics are extensively used. When typing in the program ensure that no unnecessary spaces are left, because the whole memory is needed.

POKE 16552,0(N/L) POKE 16553,0(N/L)

or else the computer will clear display and draw again. The program returns to Basic when is pressed any key. The Subroutine at address 4082h - 16514 - gives - in C register - the frequency of the tone on the ear socket.

4082: 01 00 ff 4099: 4a cb 38 db fe

3c	cb 38
20 01	d5
0c	cd b2 0b
10 f8	d1
с9	14
408e: 16 00	d5
cd 82 40	cb 72
2a 25 40	c4 2a 0a
2c	d1
c0	cb b2
41	18 e1
cd 82 40 2a 25 40 2c c0	cb 72 c4 2a 0a d1 cb b2

1 POKE36878,15 6 POKE55,18 POKE56,28 10 PRINT"INDUBARIT" LL=0 30 FORA=7168T07679 FOKEA,PEEK(A+25600):NEXT 50 FORA=7432T07503 READB

81 GOSUB800 POKE0, 197 POKE1, 0 POKE673, 0 POKE674, 11 POKE675, 33 POKE676, 34 GOTO11

139 DATA88, A1,00,CD, A4,02,D0,05,C0,14,F0,01,C8,A9,21,99,2B,1E,A9,22,99,2C,1E,8C

146 IFC=3THENE=200 147 POKE36875, B:FORD=1TOE:NEXTD:POKE36875, 0:NEXT 150 CLR: V=36875:SS=8185 160 X=7834:L=X

GOSUB500:TI\$="000000" GET A\$:SYS680

PRINT" ## 1875880

PRINT" ## 1875880

PRINT" ## 1875880

PRINT | ## 1875880

IFTI\$ | ## 187580

IFTI\$ | ## 1875880

IFTI\$ | ##

195 SYS680: IFLL=STHENH=H+=2: POKEH, 32: FORI9=1T030: POKEV+2, 210: NEXT: POKEV+2, 0
230 POKEX, 35: POKEX+1, 36: POKEX-1, 32: POKEX+2, 32
240 SYS680: X=X+AZ: IFX=L+(F*22)+21THEN POKEX, 32: POKEX-1, 32: GOSUB500 245 SYS680: POKEV+1, 240: POKEV+1, 0
246 IFLL=STHENH=H+22: POKEH, 38: IFPEEK(H-1) <> 320RPEEK(H+1) <> 32THENPOKEH-22, 32: GOS

IFLL=5THENIFH=<8120THENPOKEH-22,32

(continued on page 167)

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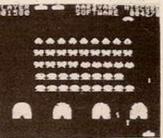
Name

AARDVARK SOFTWARE

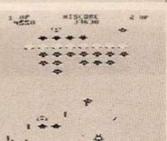
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Organisation

Andrew Dixon-Symes West Croydon, Surrey.

ORIG

THIS PROGRAM, for any size of Oric, turns the machine into a three-voice organ. It also shows how the play commands can be used to turn the certain voices on and off. The instructions are included in the program, and stay on screen while the program is running.

The second short program for Oric, demonstrates the high-resolution graphics of the machine whilst using the pattern command to give the lines being drawn a lace effect.

```
10 REM **** Three Voice Synthes; zer ****
20 REM **** Copyright:2/3/1983 ****
30 REM **** Andrew Dixon-Symes ****
42 GOSUB 520
52 :
60 PLAY7, 0, 0, 0, 0
70 K**KEY*
80 :
90 REM **** VOICE ONE ****
100 :
110 IFK*="1"THENMUSIC1, 2, 1, 4
120 IFK*="2"THENMUSIC1, 2, 3, 4
130 IFK*="3"THENMUSIC1, 2, 5, 4
140 IFK*="4"THENMUSIC1, 2, 5, 4
141 IFK*="5"THENMUSIC1, 2, 5, 4
152 IFK*="5"THENMUSIC1, 2, 10, 4
170 IFK*="7"THENMUSIC1, 2, 10, 4
170 IFK*="7"THENMUSIC1, 2, 10, 4
170 IFK*="7"THENMUSIC1, 2, 10, 4
170 IFK*="7"THENMUSIC2, 3, 3, 4
200 IFK*="8"THENMUSIC2, 3, 3, 4
200 IFK*="8"THENMUSIC2, 3, 5, 4
200 IFK*="8"THENMUSIC2, 3, 5, 4
200 IFK*="8"THENMUSIC2, 3, 5, 4
200 IFK*="Y"THENMUSIC2, 3, 12, 4
200 IFK*="Y"THENMUSIC3, 4, 1, 4
300 IFK*="B"THENMUSIC3, 4, 1, 6, 6
300 IFK*="B"THENMUSIC3, 6, 0, 0
300 IFK*="B"THENMUSIC3, 6, 0
```

```
(continued from page 165)
248 IFLL=STHENIFH=)8120THENLL=0:POKEH, 32:POKEH-22, 32
256 GOTO18
350 X=L:F=INI (RND(2)#12) HZ=INI (RND(3)#2):IFRZ=ITHENRZ=-1
516 X=X+(F*2Z):IFRZ=-1THENX=X-3
516 X=X+(F*2Z):IFRZ=-1THENX=X-3
520 RETURN
530 POKEY*2, 200:0=32
511 FORT;J=ITO10:POKEY-10, 36:FORT9=ITO60 NEXT:POKEY-10, 38:SYS680
511 FORT9=ITO60:NEXT:NEXT:POKEY*2, 0:POKEX*2, 0:POKEX*1, 0
```

10 REM **** DRIC PATTERN **** 20 REM **** Copyright 1983 **** 30 REM **** Andrew D-S **** 40: 50 PLDT18: 2, "THREE VDICE SYNTHESIZER" 50 PLDT18: 3: 70 R=INT(RND(1)*98)*108 570 A=CHR*(96)***Rndrew Dixon-Symesi1983" 580 PLDT7: 4.45 580 PLDT7: 4.45 580 PLDT7: 4.45 580 PLDT7: 8.45 580 PLDT7: 8.45 580 PLDT7: 8.5 580 PLDT19: 7, "**** INSTRUCTIONS **** 580 PLDT19: 7, "VOICE-1:Numbers 1-7 In Octave 2" 581 PLDT19: 7, "VOICE-1:Numbers 1-7 In Octave 2" 582 PLDT19: 7, "VOICE-2:Letters 0-U In Octave 2" 583 PLDT1: 10, "VOICE-2:Letters 0-U In Octave 4" 584 PLDT4: 13, "The letters on the bottom row" 585 PLDT4: 13, "The letters on the bottom row" 585 PLDT4: 15, "the chive source challed of " 585 PLDT4: 15, "the different combinations of " 586 PLDT4: 15, "the three source challed of " 587 PLDT4: 15, "the three source challed of " 588 PLDT4: 17, "7-PLL OFF, X=1 DN, D=2 DN, " 589 PLDT5: 17, "Y-PLL OFF, X=1 DN, D=2 DN, " 580 PLDT5: 17, "Me283 ON, L=1: 28 GN, " 580 PLDT5: 21, "Me283 ON, L=1: 28 GN, "

Bubbles

D J Berry, Rogerstone, Gwent.

DRAGON

BUBBLES IS A game written entirely in Dragon Colour Basic. Listing 1 is the game itself, listing 2 is a separate instructions program. You can read the instructions now to get an idea of how to play the game.

The program relies heavily on the speed of Dragon Basic graphics commands for its fluidity. Circles are drawn, un-drawn and moved to provide targets for a laser gun which is initially drawn with the Draw command and subsequently moved with Put and Get. Because I was limited to Inkey\$ for movement control the gun moves continuously — key presses modify rather than initiate movement. The only exception to this is in line 60 where Peeking location 65288 reads keyboard-matrix columns to detect when the gun is to be fired.

The graphics commands most often used in

the program are: Circle, Draw, Put and Get. Circle, as the command name implies, draws a circular form on the screen centred at X,Y and with defined radius, colour and

height to width ratio — unity for a circle, other values for ellipses. The resolution of the circle is far better in the highest graphics mode (continued on next page)

```
10 'LISTING 1 -- BUBBLES -- D. BERRY
 PUT(XGUN, C6)-(XGUN+10, C7), BLANK, PSET
                                                                                                                                                                                                                                                                                                                                       730 PUTCHAUNTAGY
740 XGUN=XGUN+MOVE
750 IF XGUN>CB OR XGUN<C3 THEN MOVE=-MOVE
760 IF XGUN<0 THEN XGUN=6
16 THE THE TOTAL OF THE T
                                                                                                                                                                                                                                                                                                                                       7780 RETURN
798 REM FIRE FIRE GUN
800 TIMER=8
810 LINE(0F,C6)-(0F,YGUN),PSET
   88 C8=6528*C1=223*C
=158*K2*26
98 C8(1)="BM286,2;"
180 C8(2)="BM211,2;"
110 C8(3)="BM216,2;"
120 C8(4)="BM221,2;"
                                                                                                                                                                                                                                                                                                                                       820 PLRY"D"
830 LINE(OF,C6)-(OF,YGUN),PRESET
                                                                                                                                                                                                                                                                                                                                       850 REM HIT? -- DRAW OUT
                                                                                                                                                                                                                                                                                                                                       860 YMX=0+TEST=0 GF=XGUN+4
870 FOR G=1 TO GU
880 IF RAD(Q)=0 GOTO 920
890 IF(OF+(RAD(Q)*ACC)XX(Q)) OR (OF-(RAD(Q)*ACC)XX(Q)) GOTO 920
130 PMODE4 SCREEN1, 8 COLOR 8, 1 PCLS
140 GET(8,8)-(26,8), BCLOUD, G
150 DRHWTBM5.5; F2R16E2U1H3L6G1L4H4L5G4D2R6"
160 PRINT(18,6)
170 GET(8,0)-(26,8), CLOUD, G
180 PUT(8,0)-(26,8), BC, PSET
190 GET(20,179)-(28,187), MB,G
200 LINE(8,8)-(255,191), PSET, B
210 PLRY*T10; ABCDEDCBR; T255"
220 TTL=9U+1
230 GOSUB 310
240 GOSUB 310
240 GOSUB 1170
260 GOSUB 1170
260 GOSUB 1480
270 GOSUB 1640
270 GOSUB 1650
280 GOSUB 170
280 IF TTL>1 GOTO 270
380 IF TTL>1 THEN GR=GR+1:RRD=RRD*8,75:MOVE=-5:XGUN=3:RCC=RCC-0.25:IF RCC(8.5 TH
EN RCC=8.5:PCLS:GOTO 280 ELSE PCLS:GOTO 280 ELSE PLAY*T5;03DDDD02B*:PRINT(2,190):
CLS(GR):PRINT*YOU LOST*:PRINT*YOU SCORED: **:PRINT FIX(DR);** POINTS*:PRINT HIT;**D
ESTROYED**:END
    138 PMODE4 SCREEN1, 8 COLOR 8,1 PCLS
                                                                                                                                                                                                                                                                                                                                        900 HTEST=1
                                                                                                                                                                                                                                                                                                                                      900 HTEST=1
910 IF Y(0)>YMRX THEN YMRX=Y(0):K=0
920 NEXT
930 IF HTEST=0 THEN YGUN=1 ELSE YGUN=Y(K)
940 IF OF>XC THEN IF XG(XC+22 THEN IF YG(C9 THEN YG=K0:GOSUB 790:RETURN
950 GOSUB 790
960 IF YGUN=1 THEN RETURN
970 REM RUB OUT & REDRAW
980 CIRCLE(X(K),Y(K)):RBD(K):1
990 RBD(K)=FIX(RBD(K)/2)
                                                                                                                                                                                                                                                                                                                                       1808 VEL(K)=VEL(K)#2:K(K)=K(K)+(RNDC?)-4)

1818 IF RAD(K)>8 THEN CIRCLE(X(K),Y(K)),RAD(K),8 ELSE HIT=HIT+1:PRESET(X(K),Y(K))
>:K(K)=8:TTL=TTL-1:GOSUB 1178

1828 DA=DA+(VEL(K)/RCC):GOSUB 1848
                                                                                                                                                                                                                                                                                                                                         1038 RETURN
                                                                                                                                                                                                                                                                                                                                        1848 REM DOOUNT PRINT DAMAGE THLLY
                                                                                                                                                                                                                                                                                                                                       1848 REM DCOUNT:PRINT DRMAGE TAL

1850 PUT(286,2)-(214,18),MB,PSET

1860 PUT(216,2)-(224,18),MB,PSET

1870 DX=DR:SCRLE=1808

1890 FOR LOOP=1 TO 4

1890 RAS=08(LO)

1100 BB=FIX:DX/SCRLE)

1110 GOSUB 1330
   ESTROYED" END
   ESTROYED" END
319 REM DCIRC DRAW CIRCLES
320 XCLOUD=0
330 FOR Q=1 TO QU
340 X(Q)=RND(255-2*RAD)+RAD
350 Y(Q)=RND(48-RAD)+RAD
360 RRDX(Q)=RAD
360 RRDX(Q)=RAD
                                                                                                                                                                                                                                                                                                                                       1110 DX=DX-BB*SCALE
1120 DX=DX-BB*SCALE/10
1130 SCALE*SCALE/10
1140 NEXT
1150 PLAY"C"
1160 RETURN
   378 VEL(Q)=15/RAD
   370 VELCQUESTRAND
380 IF XCQ>>50 AND XCQ><150 AND XCLOUD=0 THEN XCLOUD=XCQ>-12
390 NEXT Q
400 IF XCLOUD=0 THEN XCLOUD=175
410 RETURN
420 REM DGUN: DRAW GUN
                                                                                                                                                                                                                                                                                                                                      1198 RETURN
1198 RAP="BM193,2;"
1198 PUT(193,2)-(201,10),MB,PSET
1208 BB=TTL-1
1218 GOSUB 1350
1228 RAP="BM181,2;"
1238 PUT(181,2)-(199,10),MB,PSET
1248 RAP=RAME
   430 DRHW"BH3, 190, R89U1L89U1R89U1L89; BM7, 186; USR1D8"
440 GET(3,178)-(13,190), GUN, G
450 GET(28,174)-(30,186), BLANK, G
460 RETURN
   470 REM MCIRC MOVE CIRCLES
480 TIMER=0
478 REM MCIRC:MOVE CIRCLES
488 TIMER*8
499 PUT(XC,K1)~(XC+K2,K8),BC,PSET
508 XC=XC~(RND(3)~2)
518 PUT(XC,K1)~(XC+K2,K8),CL,AND
529 RN=RNC(8U)
538 IF RRD(RN)X(1 GOTO 638
540 CIRCLE(X(RN),Y(RN)),RRD(RN),1
558 PSET(X(RN),Y(RN))
568 Y(RN)=Y(RN)+VEL(RN)
579 IF Y(RN)188~RRD(RN) GOTO 388
588 X(RN)=X(RN)+(RND(7)~4)
599 IF X(RN)X18 THEN X(RN)=18
688 IF X(RN)X31 THEN X(RN)=243
618 CIRCLE(X(RN),Y(RN)),RRD(RN),8
620 PSET(X(RN),Y(RN))
630 IF TIMER(IG THEN GOTO 638
640 RETURN:TIMER CONTROLS SMOOTH GUN MOVEMENT
650 REM MGUN:MOVE GUN
660 IF PEEK(C0)=C1 THEN PLRY"C**GOSUB 858
678 MGS=INKEYS
680 IF MGS=*," THEN MOVE=C3
710 IF MGS=*," THEN MOVE=C4
720 IF MGS=*," THEN MOVE=C4
720 IF MGS=*," THEN MOVE=C5
**Continued from previous page)
                                                                                                                                                                                                                                                                                                                                       1258 GOSUB 1358
                                                                                                                                                                                                                                                                                                                                       1250 ARE="BM236,2;"
1270 PUT(236,2)-(244,10),MB,PSET
1280 BB=FIX(HIT/10)
1290 GOSUB 1350
                                                                                                                                                                                                                                                                                                                                       1300 RAS="BM241,2)"
1310 BB=HIT-(FIX(HI/10))#10
                                                                                                                                                                                                                                                                                                                                     1310 BB=HIT-(FIX(HI/10))*10
1320 GOSUB 1350
1330 PLRY"BDR"
1340 RETURN
1350 REN PRINT:PRINT ON SCREEN
1350 REN PRINT:PRINT ON SCREEN
1350 RB = "R3D7L3U7" (GOTO 1470
1360 RB = "BN+3,077" (GOTO 1470
1390 RB = "R3D3L3D4R3" (GOTO 1470
1400 RB = "R3D7L3U7" (GOTO 1470
1410 RB = "BN-3,077" (GOTO 1470
1410 RB = "R3D7L3R3U4L3" (GOTO 1470
1410 RB = "R3D3L3D4R3" (GOTO 1470
1410 RB = "R3L3D7R3U4L3" (GOTO 1470
1420 RB = "R3L3D7R3U4L3" (GOTO 1470
1430 RB = "R3L3D7R3U4L3" (GOTO 1470
1440 RB = "R3D3L3U3,BM+0,+3,04R3U4" (GOTO 1470
1450 RB = "R3D3L3U3,BM+0,+3,04R3U4" (GOTO 1470
1460 RB = "R3D3L3U3,BM+0,+3,04R3U4" (GOTO 1470
1470 DRRW RR*+RB
                                                                                                                                                                                                                                                                                                                                                          DRAW ARS+ABS
```

(continued from previous page)

PMode4. In the lower modes the circles are approximate to such an extent that with radii below about 15 their finned square shapes make useful gunsights. The Draw command is always followed by a string literal or variable which controls the movement of an imaginary cursor - up, down, left, right; plus diagonals, rotation, scaling and blank moves any number of screen points.

The gun and cloud are formed initially with the Draw command then moved around with Put and Get. The score digits are produced by concatenating strings containing draw instructions with ones containing blank move instructions then using the result as the argument for a Draw command.

Get copies graphical data from the screen and stores it in a predefined array. Put reverses the process. Put and Get are used in Bubbles to move the gun and cloud, the sequence being simply: Put blank sky where the gun is now; change the X co-ordinate of the gun; Put the gun in its new place. the cloud is moved in the same way.

The program is broken down into a series of subroutines starting with DCirc in line 310. Lines 10 to 220 perform the initial setting up, draw the screen, and cloud, set tally and score counters and set up a parameter list.

The arrays used by the program are as follows: MB stores a bit of blank sky used here and there to rub out characters and so on, X and Y are circle centres, Vel is circle 'velocity", Rad is radius, Gun has the drawn "gun" Put and Get from it, Blank is again blank sky - this time big enough to rub out the gun, and Cloud and BCloud are similar to Gun and Blank. It is important to note that Dragon Basic only recognises the first two letters of a variable name so that, for example, Bcloud and BC are the same variable. Lines 150 and 160 use Draw and Paint to fashion the nasty black cloud.

DCirc sets up each circles' variables: X,Y,Rad and Vel. It also ensures the cloud is directly in front of one of the bubbles. DGun draws the gun and stores it in array Gun.

MCIRC first moves the cloud then draws out, moves and redraws a randomly chosen circle. Line 570 asks "has a bubble reached the ground?" then jumps to a line which terminates the program if true.

MGun scans the keyboard and jumps to Hit

if the fire key is being pressed. Notice the extensive use of parameters in this often used routine. Fire simply draws the line of "laser light" from "gun" to "target". This is called from Hit which calculates whether a bubble was in the way of the shot. It uses the present Accuracy and Radius values to perform the calculation. This routine produces a parameter YGun to pass into Fire which then draws its line to the point XG,YG. Lines 970 onwards change the parameters of a hit bubble. Radius is halved velocity doubles and its centre jumps sideways.

DCount and HCount are respectively damage and hit tallies. They break the number passed to them into individual digits then use routine Print to display the values on the

Worm squirm

J S Henry, Cranleigh,

ונוטדה

THIS PROGRAM is called Worm and it runs on a fully expanded Acorn Atom in 4K. The (continued on page 173)



A two-minute operation turns your BBC Micro into the heart of a word processor.

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ACORNSOFT





(continued from page 168)

object of the game is to eat the zeros and miss the dots. There are always two zeros on the screen and when you eat one, another one appears.

If you hit one of the dots a section of your tail is cut off and another dot appears. Dots also appear after you have eaten 3 zeros. If you run into your tail or the sides you will lose a point. The game ends when you either run out of tail or trap yourself in your tail. The dots move randomly one at a time and there are machine-code sound effects.

Use i to turn you left and k to turn you right. To master the turning always imagine yourself at the head of the worm looking the direction you are always travelling. Make sure also that you do not keep the button down too long or you will turn too far. Here is a breakdown of the program:

1-95 : set up screen and machine code

100-160 : move worm

1000-1030 : set up zero 1100-1120 : set up dots

1200-1250 : check if dead end or trapped

1290-1370 : game over routine 1500-1530: move a dot at random 1999-end: instructions.

27=0;E=0

57#81=3;I=0;R=#38F0;\$R="A'?"

107#E1=0;CLERRE;S=1;IFH<10RH>9999;H=0
20MOVEO,0;DRANG3,0;DRANG3,47;DRANG,47;DRANG,0
30DIMAR21,EE20,VU5;P=#3800;P.\$21

40L=#8002;E;:VU0JSR#FE71;STY#80;RTS
50:VU1DY#81;:VU2LDX#80

60:VU3DEX;BNEVU3

70STAL;EOR#4;DEY;BNEVU2;RTS;J
80P.\$6;H=15

90FORG=1TOM;ARG=#8020+6;7AAG=-1;N,
91FORG=255T015,-4;7#80#5;LINKUV1;WAIT;N,
9500S.a;60S.a;7#81=20
1007AAM=162
110LINKUV0;Z=7#80+32;7#8002=0
11500S.x

1201=1+(Z=CH*K*)-(Z=CH*J*); I=(I+4)Z4
1300=AAM+R?I-64; IF?O<>64; BOS.c
1351F7=1; T=0; G.100
140AA(N+1)=0; ?AA(M+1)=162; ?AAM=-1
145?BA1=64
150F0RG=110M; BAG=BA(G+1); H.
160?MS0=Z*3; LINKUU1; G.110
1000aG=MS000+A.R.Z4S0; IF?G<>64; G.a
1010?G=15; FORG=17010; ?MB002=?MB002:7; N.
1020S=S+1; IFSZ3=0; SOS.b 10208=5+1; IFSZ3=0; 505.b 10308. 1100b8=#8000+R.R.Z480; IF?6<>64; 8.b 1105E=E+1; EEE=9 1110?6=46; 7#80=40; FOR6=1T010; LINKUU1; WAIT; N. 1120R. 1200cIF?0=15; 605.a; R.

13706.1360
1400c?RAM=64;FOR8=2TO10
1400c?RAM=64;FOR8=2TO10
1410?B80=6;LINKUU1;7830=255-6;LINKUU1;N.;H=H-1;F.
1500X0=A.R.ZE+1
15106=EE0+R.Z2+R.Z2+32
15201F70c764;R.
1530?EE0=64;?B=46;EE0=6;R.
1999r
2010P.''"YOU RE AT THE HEAD OF THE WORM."'"YOU MUST EAT THE "
2020P."'O'S.IF YOU HIT THE DOTS YOU WILL LOSE PART OF YOU TAIL"
2030P." MAKE SURE YOU DON'T RUN INTO YOUR TRIL OR THE WALLS OR"
2040P." YOU MIGHT TRAP YOURSELF "
2050P."USE 'J' TO MOVE LEFT AND 'K' TO MOVE RIGHT"'
2050P.""SOOD LUCK"'" PRESS ANY KEY TO CONTINUE":LI.MFFE3
2070R. 12181FARM71>64; IFAAM7-1>64; IFAAM732>64; IFAAM7-32>64; G.d 12157-0 12251F70=46;50S.e;IFM=0;6.d 1220F0RG=0T0255S.36;7MS0=6;LINKUU1;N.;T=1 1240IFRND24=0;F.G=1T010;7MS0=RND;LINKUU1;N.;S=S-1;R. 1290d7#81#2 1300CLERP4;FORS=170200;7#8000=#F0;7#80=8;LINKVU1;7#8000=#D0;N. 1305P.\$12"game over"''"YOUR SCORE WRS"S'';IFH<S;H=S 1310P."HISCORE: "H''' 1320FORG=255700S.-8;7#80=G;LINKVVI;N. 13307#30-26;FORG-1T025SS.3 13307#30-5;LINKUU1;7#30-6-10;LINKUU1;7#30-6+10;LINKUU1 1350N.;P."PRESS ANY KEY TO RESTART" 13607#30-RND;7#31-3;LINKUU1;LINKUU0;IF7#30<255;G.2

Flight of Fancy

M J Parrot, Stockport, Cheshire.

335

THE GAME is for the Model B and is the traditional 501 down, finishing on a double or the bull. Lines 10,220 give the instructions for the game, ask the number of players and take in the names of the players. If there is only one, then player 2 is assigned the name Beeb (line 210) and the logical variable Beeb is set True.

After pressing the space bar (lines 230,240) the game can begin but we first have to draw the board. This is the most complicated part of the program because some trigonometry is used. Line 1170 first sets minimum and maximum values for X and Y so that the cross-hair cannot wander off the edge of the screen. The two variables Dif and Mote are used to draw the cross-hair and move it around the board. Line 1180 Reads the scores for each sector of the board into an array S in a counterclockwise fashion beginning and ending with the 6 (at three o'clock). The origin of the graphics page is set to the centre of the screen and we are set for drawing sectors and circles around this central point. The radii which delimit the bull, the outer bull, the trebles and the doubles are set in line 1200 and two variables C and S are set to the cosine and sine respectively of 0.02 of Pi because the sectors are drawn recursively to save time. I used the triangle fill mode to draw five pairs of triangles in each segment since this nicely fills the screen leaving a clear image without unlit pixels.

The main part of the board is drawn by a pair of nested For-Next loops. The outer loop - lines 1210-1280 - steps around the board in steps of 18 degrees.

The inner loop - lines 1230-1260 - draws four segments within each sector by calling Procedure Sector. Within this loop the colour is changed alternatively between the two logical, graphical foreground colours 0 and 1 by the line 1240 which uses the variable K which was initially set in line 1200. On leaving the inner loop the logical colour is once more changed to allow for the start of the next sector.

Procedure Sector Moves the graphics cursor to the start X,Y of the segment and Draws the leading edge up to the point X1, Y1. The third point of the triangle 1 is calculated recursively and the triangles are filled in. The next (continued on page 175)

```
*FX15.1
PROCCLEARBOARD
PROCMRITESCORE
UNTILGAMEOVER
PROCWRITEND
REPEATA*=GET*:UNTIL A*="H"ORA*="Y"
IFA*="N"THENFINISH=TRUE
PROCWRITEND
VOU4
UNYIL FINISH = TRUE
                          HODE::COLURE::COLOR::SEES-FALSE
DIMERCO.S.(20).SEGRE(1).DARTX(3).DARTY(3).Hames(1)
PRINTYAB(15,2) "BEED-DARTS"
COLORS:
PRINT:PRINT"Inc game is 501 dues."
PRINT:PRINT who a double or the bull."
COLORS:
PRINT:PRINT"AIMING"
COLORS:
   BO PRINTIPRINT PRINTIPO....A Down....7"
110 PRINTIPRINTIPRINT Throw with the space bord to PRINTIPRINTIPRINT Throw with the space bord to PRINTIPRINTIPO PRINTIPO PRI
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 UNYIL FINISH = TRUE
MODEL:PRINTTAB(18,10) ** BYE*
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              130 PRINTIAN(6,200 "MII) there
140 REPEAT
150 A4-GETS
150 UNITL As*"["ORAs="2"
170 [FA4="1"] THEMSEEDSTRUE
180 PRINTIAN(6: "What's the mase of player 1"
190 INFUTAMES(0)
200 IF NOT BEER THEMPRINTIAN(6) "What's the mase of player 2":INPUTMEES(1)
210 IF DEER THEMPRINTIAN BEER WILL be player 2":NAMES(1)="BEER"
220 PRINTIPRINT*FRESS THE SPACE DAW TO PROCEED**
240 A3*GETA:UNITLAT=" "
250 MODE:19COLO, 130:CLD:GOLOURI30:COLOURG
250 PROCEDARD
   270 REPEAT
280 REPEAT
290 FORPLAYER=OTO1:SCORE (PLAYER)=501:PROCHETESCORE
500 IFLEN(NAME**(PLAYER))-&THENNAME**(PLAYER)**LEFT**(NAME**(PLAYER), 6)
510 NEXT
520 PLAYER**1
530 GAMEGVER=FALSE
                                                          PEAT
PLAYER*ABS(FLAYER-1):DART=0:TSCORE*0
PROCHRITENAME
                                                    PROCURTIFICATION
REPEAT
DART+DART+!
DOUBLE-FALSE:BLBT-FALSE:WIREFLAG-FALSE
x=RND(470)-235;V=RND(470)-235
PROCUNTEROSS
IFFDINT(X,Y)-2AND RND(7)=2THEN WIREFLAG-TRUE-
PROCDART(X,Y)
-EVALS:
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             IFY YEAR THENY-YMAX
PROCESS

AN-INELY*(10)
PROCESS
IFA*-R* Y+Y+MOIE
IFA*-R* Y+Y+MOIE
IFA*-R* X-X-MOIE
                                                                      PROCDART(X,Y)
*FX15,1
PROCHED
PROCSCORE
IFR(R(1) OR R)R(S) THENNIREFLAG=FALSE
PROCEDIALISE
PROCEDIALISE
UNITL DART=3 OR SAMEDVER OR BUSY
NOT BUST THENSCORE(PLAYER) ~SCORE(PLAYER) -TSCORE
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                (listing continued on page 175)
```

ZX81 MACHINE CODE?

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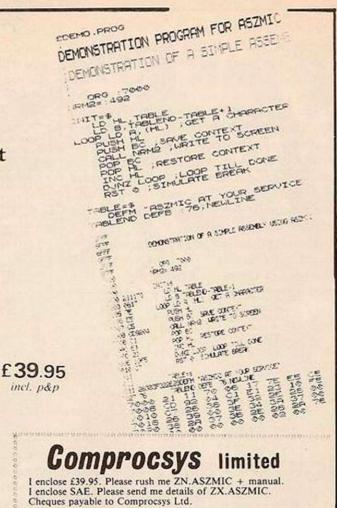
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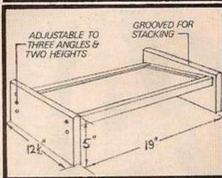


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```
(listing continued from page 173)
                                                                                                                                                                                                                                                                                                                                                                                                                                                                           PRINTTAB(1+PLAYER*35,4); "PRINTTAB(1+PLAYER*35,4); "CORE; IFFLAD PRINT """
                      | MOVEX.-DIF.Y
| DEGMET-DIF.Y
| DEGMET-DIF.
| DEGMET.-STORED | DEF
| EMBET-DIF.
| DEF | FROLEDISED
| DEF | FROLEDISED
| DEF | FROLEDISED
| DEF | FROLEDISED
| SUBJECTION | DESCRIPTION |
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           PROCELEARBOARD
                                                                                                                                                                                                                                                                                                                                                                                                                                                                     DEF PROCCISCLE(R)
C=COS(0,05):S=SIN(0,05):X=R:Y=0
                                                                                                                                                                                                                                                                                                                                                                                                                                                 1830 HOVEX,Y
1850 KORJ-170128:1-x*C-Y*S;Y-Y*C+X*G:X-1
1850 DRAWX,Y
1870 NEXT3
1880 ENDFROC
                                                GCOLD, KiK=ABS(K-1)

PROCSECTOR(R(L)*C1,R(L)*S1,R(L*1)*C1,R(L+1)*S1)

NEX (L

DUL 0, XIK=ABS(K-1)
                                                        01019:M0VE490*COS(I*PI/10)-300-25*((S(I)=18)*(S(I)=13)*(S(I)=10)*(S(I)
| 1300 | PRINTS(1):NEX1
| 1310 | GCDL0.2
| 1320 | FCRI=F1/20YC2*P1-P1/20STEPP1/10
| 1330 | X=R(5)*CDS(1):Y=R(5)*SIN(1)
| 1340 | HOVEO,0:DRAWX,Y
| 1350 | NEXT
| 1360 | FOR)*2104:PROCCIRCLE(R(1)):NEXT
                                                                                                                                                                                                                                                                                                                                                                                                                                                                        SCORE = (SCORE (PLAYER) -1
IFSCORE -1NT (SCORE) (.11
FK(0)+5;X=P*COS (THETA):
PROCRANDOM
ENDPROC
DEF PROCRANDOM
D=FRID (3) -2:E=FRID (3) -2
X=X+D*13:Y=Y+E*13
XHDPHOC
    1380 C-P1/10:MOVEO.0
1390 C-P1/10:MOVEO.0
1390 FGH1-:TO21:X-R(0) *COS(C*(1-1)):Y-R(0)*SIN:C*(1-1))
1400 MOVEO.0:PLOISS.X.Y
1410 MEXII
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      COME (PLAYER) - ISCORE)/2
INTOSCORE): ITHENIAOTREPEATITHITHIUNTIESCORE S(I)ITHETA=PI*I/10-PI
AP*COS(THETA):Y*R*SIN(THETA):ELSEX*BO:Y*330
    1430 ENDPROC
1450 DEF PROCSECTORYX,Y,X1,Y1)
1450 MOVEX,Y:DRAWX1,Y1
                             FORD.1100

I=x*C-Y+S:Y=Y*C+X*S:X*T

PLOTBS,X,Y

I=xI*C-YI*S:YI=YI*C+XI*S:XI=T

PLOTBS,X1,YI

NEXIJ
     1550 DEF PROCTOTALISE
1550 DEF PROCTOTALISE
1560 IFSCORE-SCORE(PLAYER)-TSCORE ANDDOUBLE-TRUE THEN GAMEDVER*TRUE:ENDPROC
1570 ISSCORE-TSCORE(PLAYER)-TSCORE-TTHENPROCBUST:ENDPROC
1580 ISSCORE-TSCORE+SCORE
1590 ENDPROC
     1590 ENDPROC
1610 DEF PROCDUST
1620 SOUND 1,-15,100,10
1630 BUST=TRUE
```

(continued from page 173)

triangle 2 is drawn and then on the next pass of the loop two new points are calculated and two new triangles are filled in. In this way each segment of each sector is drawn using pairs of triangles.

Lines 1290 and 1300 print the scores — the array S — around the board by calculating the necessary points on the circle, and slightly adjusting the position for the numbers 18, 13, 10 and 15 so that the board appears balanced. Note that the Text and Graphics Cursor were combined in line 1190. Line 1360 draws the wires around the board using the Procedure Circle with the necessary radii being passed to it. The only thing left to do is draw the bull in the centre; again done by the Plot 85 command.

The game proceeds by a set of nested Repeat-until loops. The outer is controlled by the logical variable Finish which only becomes true when the player elects to end the game in lines 580, 590.

The next inner loop — lines 340-560 — is controlled by the logical variable Gameover which is set true in Procedure Totalise if the scoring is okay for a permissible finish to the game.

The next loop in is controlled by three variables, Dart, Gameover, and Bust. The latter is set true in Procedure Bust if the cumulative score — the variable TScore — for the three darts — controlled by the counter Dart — is greater than the score — Score (Player) — already obtained by the player.

In the innermost loop a series of Procedures first move the cross-hair around the board using the GCOL 3 command to first draw—line 980—and then erase—line 1000—a cross at a position X,Y which is randomly moved in a Repeat-Until loop unless the player moves it.

Within this loop a check is made - line

1050 — to see if the machine should play, in which case Procedure Mygame is invoked. Here a series of simple If statements is used to make a decision about where to land a dart. X and Y are set but to make it fairer X and Y are randomised by the same degree to which the cross-hair's movement is subjected.

Line 420 checks to see whether a wire has been hit. Because they were drawn in the background colour 2 - yellow - line 470 has to reset the logical variable Wireflag back to False if the point was really off the board or in the 25 region. This could have been allowed for in line 420. Note that the darts are drawn in yellow on a black background and so hitting a dart can result in a zero score and the message "wire". The rest of the program is concerned with drawing the dart, writing the score of each individual dart, and writing the scores of the players together with their names. The only complicated part occurs in Procedure Score. Here the position of the dart is first remembered by the arrays DartX and DartY for subsequent removal and then the radial distance of the dart from the board's centre is calculated in line 680. A series of Ifs then checks this radial distance R to provide initial scorings. The order of these is quite important because the number of checks can be kept to a minimum. Thus scores of 50, 25 and 0 are easily checked. After checking - line 710 - for the wire having been hit, the angle measured anti-clockwise round the board from the middle of the 3 o'clock sector - that scoring 6 — is calculated by the ACS function - line 720 — which may have to be adjusted if the dart is in the bottom half of the board.

The next line, 730, essentially takes this angle Theta and divides it by PI/10 to calculate which sector the dart is in and therefore which array element will provide the score. PI/20 is subtracted to allow for the counter-clockwise rotation around the circle.

Now here comes the slightly non-mathematical "adjustment" to make the scoring right. If the dart were to land in the bottom part of sector 6 the measured angle would be slightly negative and so 1 should be added to the calculation to give the array element. However, because of the way the sectors were drawn, the trigonometry is slightly awry and so I only add 0.7. This makes the scoring correct as it appears on the screen. Having found which sector the dart is in, it is an easy matter to check for doubles and trebles by looking at the radial distance from the centre of the board lines 740-750. If the score is a double then the logical variable Double is set true. Note that it is also set true if 50 is scored because it is used to check for a legal end to the game in line

Synthesiser

Andrew Parker, Warrington.

CBM-60

THIS PROGRAM uses all the features of the 64's sound chip, using the whole of the keyboard to play like a musical instrument. H occupies 10K of memory. The keyboard is set out as (continued on page 176)

```
5 POKES3280.0 POKES3281.0

10 FRINT"37

15 FRINT"3 THE COMMODORE 64 MUSIC SYNTHESISER #1.25 PRINT"3 THE COMMODORE 64 MUSIC SYNTHESISER #1.25 PRINT"3 THE COMMODORE 64 MUSIC SYNTHESISER #1.25 PRINT"8 PRINT"THIS USES THE FIRST VOICE OVER A RHADE" 46 FRINT"0F NEARLY 3 OCTAVES"

30 PRINT"THE WAVEFORM IS CHANGEABLE DUING USE BY 37 FRINT"HE WAVEFORM IS CHANGEABLE DUING USE BY 37 FRINT"HE SHAND PULSE AND $7.79 FOR NOISE"

50 PRINT"ABE AND PULSE AND $7.79 FOR NOISE"

50 PRINT"ABE AND PULSE LEVELS IF REQUIRED"

50 PRINT"ABE AND PULSE LEVELS IF REQUIRED"

50 PRINT"ABE AND SCLEAMONE®

50 PRINT"ABE AND PULSE THE KEYS 2.3.4.6.7.9.0.+."

51 PRINT"ABE AND SCLEAMONE®

50 PRINT"ABE AND SCLEAMONE®

51 PRINT"ABE AND SCLEAMONE®

52 PRINT"ABE AND SCLEAMONE®

53 PRINT"ABE AND SCLEAMONE®

54 PRINT"ABE AND SCLEAMONE®

55 PRINT"ABE AND SCLEAMONE®

56 PRINT"ABE AND SCLEAMONE®

57 PRINT"ABE AND SCLEAMONE®

58 PRINT"ABE AND SCLEAMONE®

59 PRINT"ABE AND SCLEAMONE®

50 PRINT"ABE AND SCLEAM
```

(continued from page 175)

shown in the diagram, the keys from Z to the oblique stroke acting as normal notes and the keys S, D, G, H, J, L and, acting as the sharps. The same is true for the top two rows of keys. The sharps are on 2, 3, 4, 6, 7, 9, 0, +, £ and the CLR/HOME key. This gives a range of just over three octaves.

The waveform can either be triangle, sawtooth, pulse or noise. These govern the shape of the sound wave. The attack-decay and sustain-release determine how long it takes for a note to reach its peak volume - attack - to fall from its peak volume to sustain level decay - how long it stays at this level sustain - and how long the note takes to fall from the sustain level - release.

The waveform can be changed during the running of the program by using the function keys (see program listing). The instructions are contained in lines 10-95. Lines 100 to 230 read in the high and low frequency values into an array. The place in the array into which the note is placed is governed by the value in the keyboard buffer (location 197) for that key. The main locations are:

54296-Volume control 54273-High frequency 54272-Low frequency 54276-Waveform 54275-High pulse

54274-Low pulse 54277-Attack/Decay 54278-Sustain/Release

These locations are used for voice one only, voices 2 and 3 have different locations. In Line 462, Poke 198,0 clears the keyboard buffer after each key.

(listing continued from page 175)

```
410 INPUT"LOW PULSE (0-255)*;P(2)
420 FEM+*KEYBORRD SCRN+*
430 FOKELPE.P(1) FOKEHPE.P(1)
430 FOKESR.L(2)
430 FOKESR.L(2)
435 FOKEWFK.R
460 S=PEEK(197)
462 FOKE198.0
463 GOSUBZORD
465 IFS=60THENPOKEYOL.0 FOKEWFM.0 FOKEAD.0 PCKESR.0
GOTOSPS9
430 IFS=64THENPOKEYOL.0 FOKEWFM.0 FOKEAD.0 PCKESR.0
GOTOSPS9
430 IFS=64THENPOKEYOL.0 FOKEWFM.0 FOKEAD.0 PCKESR.0
    493 IFS=64THEN460
500 FOKEHFR.NO(S.1)
510 FOKELFR.NO(S.2)
515 IFFEKK(197)=STHEN515
520 POKEMFM.0
    $13 60T0430

2000 FFS=4THENE=17

2010 FFS=5THENE=33

2020 FFS=5THENE=55 G0T0440

2030 FFS=5THENE=129

2040 FETUPN

$200 FOREED 0 POKESE, 0 FORENEM, 0

3399 FETUTO
```

lape examiner

M Salmon, Abingden, Oxfordshire.

プンゴグブスリン

THE SPECTRUM saves files as two blocks header and data. The data may be of any length and could represent anything, so the header is needed to tell the Spectrum how to interpret the data. The header is composed of 17 bytes, as follows:

offset description

file type: 0 = program, 1 = number 0 array, 2 = string array, 3 = bytes 1-10 filename in ASCII

total length in bytes of data to be read 11-12

special

15-16 program length in bytes

Bytes 13 and 14 are used for any specific information required. For type 0 files it contains the auto-run line number - unless it is more than 32767 which signifies load only. For type 3 files it contains the start address for Load "" Code with no parameter. For types 1 and 2 only byte 14 is used. This contains packed information for the aid of the floating point calculator. Bits 0-4 give the ASCII code minus 64 of the original array saved and bit 6 tells what type of array it is (0=number, 1 = string). Bit 7 is always set.

The table above is given with offsets as the method used for reading files from tape is by calling a routine with a buffer pointed to by the 16 bit index register IX.

The program contins a small machine routine to do this:

XOR A 175 55 SCF 221,33,16,127 LD IX,32528 205,86,5 **CALL 1414** 201 RET

This is set up by lines 10-30. Line 40 sets B to point to the buffer and sets up a user-defined function to extract a double-byte number from an offset X.

Line 50 calls the machine-code subroutine and the Spectrum waits for a header to come in from the cassette port.

```
10 CLEAR 32511 TO 32521: READ
b: POKE a,b: NEXT a
30 DATA 175,55,221,33,16,127,2
05,86,5,201
40 LET b=32528: DEF FN a(x)=PE
EX (b+x)+256*PEEK (b+x+1)
50 RANDOMIZE USR 32512
60 LET c=PEEK b
70 IF c>3 THEN GO TO 50
80 PRINT "Filename:
90 FOR a=b+1 TO b+10: PRINT CH
R$ PEEK a; NEXT a
100 PRINT: PRINT THB 4;")9PE:
  100 PRINT : PRINT THB 4;") ype:

110 GO SUB 1000+100*c

120 PRINT : PRINT

125 POKE b.255

120 GO TO 50

1000 PRINT "Program"

1010 PRINT "Total (ength: ";FN a
(11);" bytes"

1020 PRINT "Program (ength: ";FN
a (15);" bytes"

1020 IF FN a (13);9999 THEN PRINT

"Load only": RETURN
1040 PRINT "Runs from time ";FN
a (15)
1050 RETURN

1110 LET a$="": GO TO 1220
1200 PRINT "Character array"
1210 LET a$="$"
    a(10)
1050 RETURN
1100 PRINT "number array"
1110 LET a$="": GO TO 1220
1200 PRINT "character array"
1210 LET a$="$
1220 PRINT "Array length: ";FN a
111); "bytes"
1230 LET d=PEEK (b+14)
1240 PRINT "Original array name:
";CHR$ (64+32*(d/32-INT (d/32))
138
   "; CHR$ (84+32*(d/32-1N) (d/32))
); a$
1250 RETURN
1300 IF FN a(11) = 6912 AND FN a(1
3) = 16384 THEN PRINT "screen imag
e": RETURN
1310 PRINT "bytes"
1320 PRINT "Start address: "; FN
a(13)
1330 PRINT "Length: "; FN a(11); "
bytes"
1340 RETURN
```

Line 60 extracts the filetype and line 70 skips the output section if it decides that this is not a header. Lines 80-100 print the filename and line 110 chooses the appropriate routine to use for decoding on the basis of the filetype. This means that it is vitally important that the routines starting at lines 1000, 1100, 1200 and 1300 remain at these lines - otherwise numbering is unimportant. Line 1300 is the only other interesting point - it automatically decides whether a bytes file is a screen image

Spectrum owners with an understanding of machine-code and a good disassembler should find the area of the ROM between 4C2 and 9F3 - hex - interesting to inspect as the tapehandling routines are self-contained. I would advise starting at 605 hexadecimal as this is the highest level of tape handling. The prospective decoder should be helped by the knowledge that the low byte of TADDR will contain a byte ranging from E0-E3 corresponding to the keywords Save, Load, Verify and Merge respectively.

Memory man

TR Carey, Southampton, Hampshire.

33-31

IF YOU want to know how much memory has been used by various things this program will run on any ZX-81 but it is not really suitable for the 1K machine as the memory is very limited. Using the memory map on page 177 of the ZX-81 manual and the systems variables on pages 177/9. The systems variables are used to find the addresses of different parts of the memory. This program is very useful when writing programs and it can be removed afterwards.

9996 PRINT TAB 8;"ZX 81 MEMORY" "TOTAL RAM", ((PEEK-16388 + 256*P EEK 16389)-16384)/1024;" K" 9997 PRINT ,,"BASIC PROGRAM", (PE EK 16396 + 256*PEEK 16397)-16509;" BYTES"

9998 PRINT , "VARIABLES", (PEEK 1 6404 + 256*PEEK 16405)-(PEEK 16400 + 256*PEEK 16401)-1;" BYTES" 9999 PRINT,, "SPARE MEMORY", (PEE K 16388 + 256*PEEK 16389)-(PEEK 16 404 + 256*16405);" BYTES"

Definer

Brian Etherington, Hanslope, Milton Keynes.



THIS IS A MULTICOLOUR character definer for a 32K BBC Micro. The cursor is moved around an eight by eight grid to define a new character. As new pixels are added or deleted from the new character, the VDU statement parameters are updated on the right-hand side of the grid, in line with each of the eight grid rows. Similarly, the character is displayed in mode 2 graphics to the left of the larger grid. At the bottom of the screen in a 16-colour paint palette, the current ink colour is indicated by the arrow. The ink colour is, changed by pressing the space bar. In this (continued on page 179)

THE CURSE

"Know, Oh Prince . . .

There was a time when the world cowered in the shadow of the Dark Ring, Shedir, and the people cried out for a hero."

THE LEGEND

"... and it was foretold that a hero would come at last. An adventurer, maybe a great wizard or yet a lowly thief, maybe the son of man or mayhap of elvenkind ..."

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ARTIST'S DESIGNER

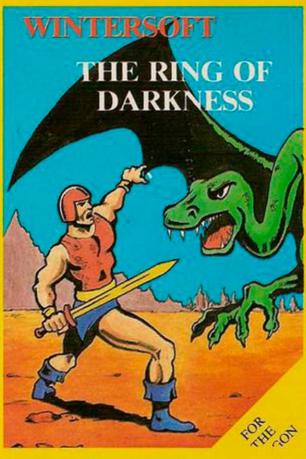
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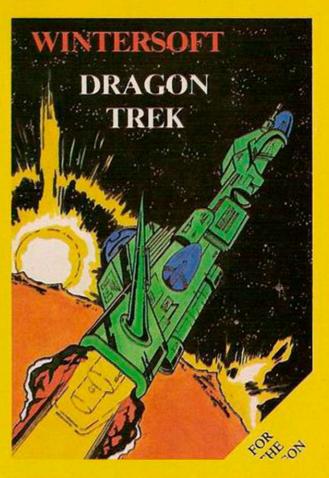
WINTERSOFT

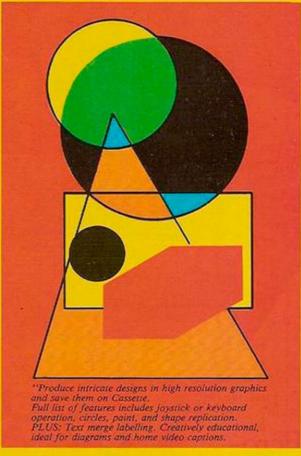
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(continued from page 176)

way, overlaid multicoloured graphics characters may be defined and automatically displayed. The VDU parameters are displayed for each colour as you step through the paint palette.

The program has been written in fullystructured Basic and makes extensive use of BBC Basic procedures. The only Goto statement in the entire program is at line 140. Note the procedure Cursoron at line 1200 redefines a different form of cursor to that which is normally available. I believe that this program represents a valuable software-development tool for the BBC microcomputer, and is unusual in that it allows for multi-coloured

character generation. In addition, the program is an example of good programming technique for those just learning the craft. Multicoloured characters can be printed using the VDU5 and move commands. The following example prints a character in red, white and blue. It assumes that characters 224-226 have been defined by the user:

- 5 MODE 2
- 10 BLUE\$ = CHR\$ 18 + CHR\$ 0 + CHR\$ 4
- 20 RED\$ = CHR\$ 18 + CHR\$ 0 + CHR\$ 1 30 WHITE\$ = CHR\$ 18 + CHR\$ 0 + CHR\$ 7
- 40 A\$ = BLUE\$ + CHR\$ 224 + CHR\$ 8 + RED\$ + CHR\$ 225 + CHR\$ 8 + WHITE\$ + CHR\$ 226
- 50 VDU 5
- 60 MOVE 640, 512 : PRINT A\$



Use normal cursor movement keys to position cursor. Make cop Wark using the DELETE key. Press SPACE BAR to change ink colour. Press ESCAPE to define new character

```
28 REM * MULTI-COLOUR CHARACTER DEFINITION PROGRAM * 48 REM *
              REM * AUTHOR :- B.J.W.ETHERINGTON
REM * JANUARY 1983
                                                                                                                                                                                                         780DEF PROC_MARK(A%)
790IF GRID%(Y%,X%)=A% ENDPROC
800COLOUR A%
       818VDU 224,8
     90 REM
100 ON ERROR RUN
110 DIM GRIDX(8,8),ROWX(15,9),SHRDE#(15)
                                                                                                                                                                                                         8281F GRID%(Y%,X%)<>0 TINK%=GRID%(Y%,X%):GRID%(Y%,X%)=0:PROC_CALC(TINK%)
838GRID%(Y%,X%)=0%
848 PROC_DISPLAY
858ENDPROC
128 MODE 2

130 PROC_INITIALISE

140 PROC_INPUT GOTO 140

150 DATA RED, GREEN, YELLOW, BLUE, MAGENTA, CYAN, WHITE, FLASH BLACK-WHITE, FLASH RED-CYAN, FLASH GREEN-MAGENTA, FLASH YELLOW-BLUE, FLASH BLUE-YELLOW, FLASH MAGENTA-GREEN, FLASH CYAN-RED, FLASH WHITE-BLACK
                                                                                                                                                                                                        918INK%=INK%+1
                                                                                                                                                                                                         9201F IN(X)15 IN(X=1

930PRINT TAB(IN(X+1,30))CHR$(244);

940PRINT TAB(0,11);STRING$(40,"")

950 PRINT TAB(0,11);SHADE$(IN(X))
    188#FX4,1
198FOR IX=1 TO 8:FOR JX=1 TO 8:GRIDX(IX,JX)=8:NEXT:NEXT
288FORIX=1 TO 15:ROWX(IX,9)=8:READ SHADEs(IX):NEXT
218XX=1:YX=1
228 VDU 23,224,8FF,8FF,8FF,8FF,8FF,8FF,8FF,8FF,8FF
238 VDU 23,240,3,1,1,1,1,1,1,1,3
248 VDU 23,241,0,0,0,0,0,0,129,255
259 VDU 23,241,0,0,0,0,0,0,0,0,0
268 VDU 23,243,192,128,128,128,128,128,128,192
278 VDU 23,244,16,16,16,16,16,84,56,16,0
288PROC_SCREEN
298PROC_SCREEN
                                                                                                                                                                                                         960COLOUR INK%
                                                                                                                                                                                                         970PROC_VDU
980PROC_MOVE(0,0)
990PROC_CURSORON
                                                                                                                                                                                                       1000ENDPROC
                                                                                                                                                                                                       290PROC_CURSORON
                                                                                                                                                                                                       1848PROC_VDU

1858 VDU 5

1868 MOVE 192,847

1878 VDU 9,127

1898FOR IX=1 TO 15

1898FR ROWX(IX,9)=1 PROC_SHOW(IX)
      300PROC_MOVE(0,0)
     310PROC_DISPLAY
320ENDPROC
   338EMPROL

338EMPROL

340DEF PROC_SCREEN

350CLS:COLOUR 7

360PRINT " CHRRACTER DEFINER"

378 COLOUR 2

380 PRINT TAB(8,14); "Use normal cursor";

390PRINT TAB(8,15); "movement keys to";

400PRINT TAB(8,15); "movement keys to";

410 PRINT TAB(8,16); "position cursor.";

410 PRINT TAB(8,18); "Make a mark usin9";

420 PRINT TAB(8,19); "the COPY key.";

430 PRINT TAB(8,21); "Erase a mark usin9";

440 PRINT TAB(8,22); "the DELETE key.";

450 PRINT TAB(8,25); "chan9e ink colour.";

470 PRINT TAB(8,25); "chan9e ink colour.";

470 PRINT TAB(8,25); "define new character";

480 PRINT TAB(8,28); "define new character";

490 FOR IX=1 TO 15:COLOUR IX:PRINT TAB(1X+1,31); CHR$(224); NEXT

580 INKX=6

510 PROC_INK

520PRINT TAB(6,1); STRING$(8,CHR$(241));
      1100NEXT
1110 VDU 4
1120 COLOUR INK%
                                                                                                                                                                                                       1130PROC_MOVE(0,0)
1140PROC_CURSORON
1150ENDPROC
                                                                                                                                                                                                       1170 DEF PROC_CURSOROFF
1180VDU 23,0,10,32,0;0;0;
                                                                                                                                                                                                       1190 ENDPROC
                                                                                                                                                                                                       1278 GOOL 8, RX
1288/VDU 23, RX+224, ROME(RX, 1), ROME(RX, 2), ROME(RX, 3), ROME(RX, 4), ROME(RX, 5), ROME(RX
    550 VDU 31,14,2,243,8,10,243,8,10,243,8,10,243,8,10,243,8,10,243,8,10,243,8,10
                                                                                                                                                                                                       1300 VDU 8%+224
1318 ENDPROC
                                                                                                                                                                                                       588DEF PROC_INPUT
598 A=GET
600 IF A=&89 PROC_MOVE(-1,0):ENDPROC
610 IF A=&89 PROC_MOVE(1,0):ENDPROC
620 IF A=&89 PROC_MOVE(0,-1):ENDPROC
630 IF A=&80 PROC_MOVE(0,-1):ENDPROC
640 IF A=&20 PROC_INK:ENDPROC
650 IF A=&87 PROC_MARK(INKX):ENDPROC
650 IF A=&87 PROC_MARK(0):ENDPROC
650 IF A=&87 PROC_MARK(0):ENDPROC
650 IF A=&74 PROC_MARK(0):ENDPROC
650 IF A=&75 PROC_MARK(0):ENDPROC
                                                                                                                                                                                                       1340ROWX(8%,9)=0
                                                                                                                                                                                                       1388RON(AX,IX)=0
1370FOR JX=1 TO 8
1370FOR JX=1 TO 8
1388IF GRIDX(IX,JX)=AX RONX(AX,IX)=RONX(AX,IX)+(2^(8-JX)):RONX(AX,9)=1
                                                                                                                                                                                                        388EKT HEXT
                                                                                                                                                                                                        1420DEF PROC_VDU
1430PROC_CRLC(INK%)
     670ENDPROC
                                                                                                                                                                                                       1440COLOUR 7
1450FOR 1%=1 TO 8
1460PRINT TAB(15,1%+1);" ";
1470PRINT TAB(15,1%+1);ROWK(INK%,1%);
    718IF XX>8 XX=1
```

Rally racer

DTC Breslin, Byfleet, Surrey.



HERE IS A program for the Acorn Atom which

tests a player's ability to steer down a twisting lane. Using a combination of Atom Basic and resident assembler, the program uses under 2K of memory, and also graphic mode 2a colour - so the screen RAM and floating point ROM must be fitted. The road is shown in a 3-D image as white dots and every time (continued on page 181)

10 IF ?#99<>0 W=0;?#99=0 20 GOS.s 30 @=0

40 DIM LL5

50 F.J=0T020;LL(J)=-1;N. 60 P.\$21;F.J=1T02;P=#2800

(listing continued on page 181)

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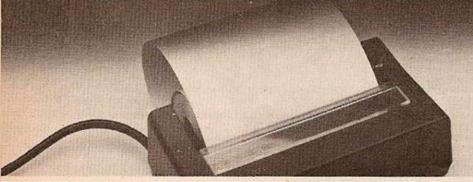
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Print'n' Plotter

SOFTWARE FILE

(listing continued from page 170)	310aK=R.%H)?#9A=K)F.J=0T0A.R.%5+3;C=C+1
(listing continued from page 179)	320 IF C%500=0;H=H+1;?#9E=H-1;?#9F=-H+1;GOS.d
70E	330 LI.LL0
80:LLØ JSR LL3;LDA #9A;CLC;ADC #9B;STA #9B;STA #3B1F;STA#3A1F	340 ?B=?B:4
90 JSR #FE71;LDA @0;STA #90	350 IF ?#91<>0;?#15=?#15-1;G.9
180 CPY @1; BNE LL1	360 ?B=?B:4;N.;G.a
110 LDA #9E;STA #90;CLC;ADC #9B;STA #9B	370bP.\$12"YOU SCORED "C" POINTS"'''
120:LL1 CPY @3:BNE LL2	380 IF C>W;W=C
130 LDA #9F;STA #90;CLC;ADC #9B;STA #9B	390 P." HIGH SCORE IS "W''''
140:LL2 LDR #8002;EOR@4;STA#8002;RTS	400 P. "PRESS ESPACE BARI FOR ANOTHER GO"'/LI.#FFE3;RUN
150:LL3 LDX @0;STX #5B;STX #5D;STX #5E	4109F.J=0T0200;?B=?B:4&R.N.;L=L+1
169:LL4 STX #5C	420 IF L=3;G,b
170 LDA #3A00,X;STA #5A;CLC;ADC #90;SEC;SBC @1;STA #39FF,X	430 G.h
180 JSR LL5;LDX #5C;LDA #39FF;X;STA #5A;INC #5E	440dP.\$7; IF H=2; G. 460
190 DEC #5C; JSR LL5; DEC #SE; INC #5C	450 F.O=1TO H;MOVE((0-2)*2),61;DRRW((0-2)*2),63;N.
200 LDX #5C;LDR #3B00,X;STR #5A;SEC;ADC #90;STR #3AFF;X	460 R.
210 JSR LL5;LDX #5C;LDA #3AFF,X;STA #5A;INC #5E	470sCLEAR0; P.\$30
220 DEC #5C; JSR LL5; DEC #5E	480 F.J=35T045;MOVE22,J;DRRW45,40;N.
230 LDX #5C; INX; INX; CPX @32; BNE LL4	490 P. ''" "\$9"lombard"'''
240 LDR #87CE; ORA #87CF; ORA #87D0; ORA #87D1; STA #91; RTS	500 P. "STEER YOUR CAR AS FAR AS YOU CANDOWN THE ROAD BY THE"
250:LL5 JMP(#3FE)	510 P." KEYS :-"'
260J;N.;P.\$6	520 P. " ["\$95" LEFT"''
270 C=0;L=0;B=#B002;H=2;K=1;?#9E=1;?#9F=254	530 P."] "\$95" RIGHT"/
280hCLEAR2;COLOUR1;?#98=64;!#87EE=-1;GOS.d	540 P.''" PRESS SPACE BAR TO CONTINUE"
290 F.J=0T032;J!#3R00=32+J;J!#3B00=96-J;N.	550 LINK#FFE3
300 LI.LL3;F.J=0T0180;WAIT;N.	560 R.
(continued from page 179)	

(continued from page 179)

500 of these disappear off the bottom of the screen, the degree of difficulty increases until the player crashes three times. The score obtained and high score is printed and the game starts again.

Extra tools

Peter Barney, Letchworth, Hertfordshire.

SPECTRUM

USERS OF Bobby Rao's toolkit machine-code routines for the Spectrum — page 77, February, Your Computer — may find these routines useful also. List 3 and list 4 are high-resolution left and right scrolls, but in each case, the byte listed as 55 or 63 — use only one — will scroll with wrap-around if 63, or with a white pixel from left or right, as appropriate, if 55. This same byte Poked 0 gives inverse characters with wrap around.

List 1 and list 2 are high-res up or down scrolls, which may be of interest as they are much shorter — 53 and 55 bytes — than the 99 and 97 of the published routines.

I have given the listings in decimal as I find these far easier to enter than hexadecimal. A suitable routine for entering the codes is given on page 180 of the manual.

The trap

Colin Hagreen, Orpington, Kent

DRAGON

TRAP IS A game for two players, each player directing a line around the screen trying to force their opponent to hit one of the tracks S REH Demo Frogram
10 CLEAR (FED: 23675-256-FEEX: 23676-200)
40 GO SUR 120
65 IF INEVER-1 THEN FOR 32533.0; FORE 32563.0
65 IF INEVER-2 THEN FORE 32533.0; FORE 32563.0
65 IF INEVER-2 THEN FORE 32533.0; FORE 32563.63
60 IF INEVER-2 THEN FORE 32533.0; FORE 32563.63
60 IF INEVER-2 THEN FORE 32533.0; FORE 32563.63
60 IF INEVER-2 THEN FORE 32533.0; FORE 32565.05
61 IF INEVER-2 THEN FORE 32553.0; FORE 32565.05
61 IF INEVER-2 THEN FORE 32553.0; FORE 32565.05
61 IN GO TO 150
61 IN

formed or the boundaries of the court. Beware though as you can sometimes escape by cutting through a diagonal line. Be careful not to centre the joystick or you lose the game.

To start a game both players have to press the fire buttons. The overall winner is the first to score 10 wins. The lower-case letters in lines 350 and 360 are typed as inverse characters. PCopy is used to store the courts in another area of memory and lines 120 and 130 bring them on to the display faster than could be obtained by drawing them each time.

```
> SREM (C) C. HAGREEN '83
10 PCLERR6
20 PMODE1.9
30 PCLS
40 LINE(8,0)-(8,192), PSET (LINE-(255,192), PSET (LINE-(255,0), PS
ET (LINE-(0,0), PSET
50 PMODE1.5
60 PCLS
70 PCDPY3 TO 5 (PCDPY4 TO 5
80 LINE(50,50)-(50,150), PSET (LINE(200,50)-(200,150), PSET
90 R5=0 (S=0
110 X=RND(2)
120 PCDPY(X*2)+1 TO 1
130 PCDPY(X*2)+2 TO 2
140 PMODE1.1 SCREEN1.0
150 X=20 YEX (3) YEX
```

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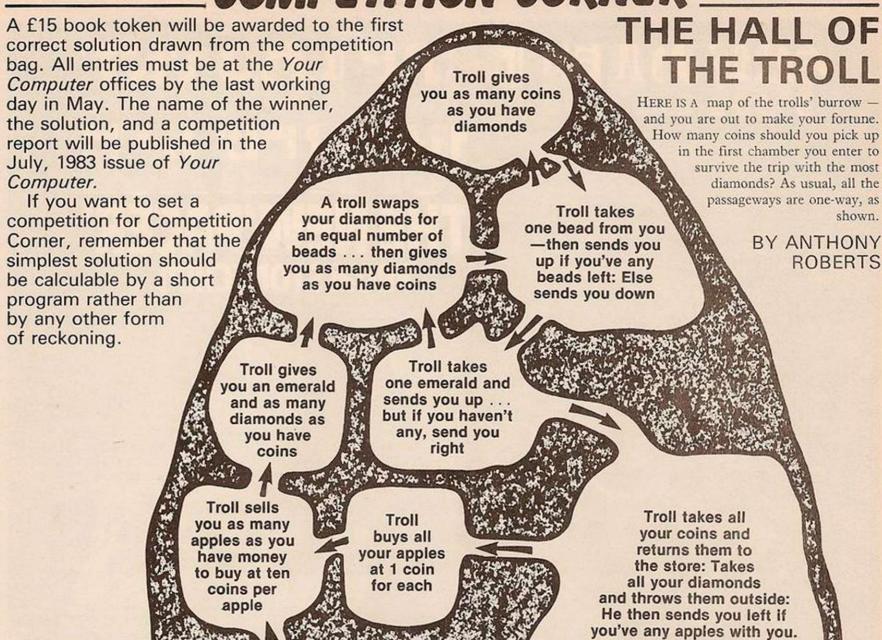
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COMPETITION CORNER



Competition results



IN MARCH'S competition to win a Lynx computer competitors were asked to complete the sentence, "A Lynx would bring out the animal in me because . . .".

Take some—

not all-of

the 1000 coins

in the store

of coins here

The prospect of winning a Lynx may not have brought out the animal in everyone but it certainly brought out the punsters, in force. "I could relion my feline instincts for purrfect programming", wrote G Bockhurst, while H Howarth suggested "It's the big-byte cat-grrreat grrraphics and a purrfect purrocessor to boot".

The winning entry came from the appropriately-named Dave Bull, 86 Milton Road, Southampton, Berkshire, who wrote "It's the purrfect way to be an on-line feline".

Some of the other puns were more obscure. We are still trying to puzzle out A Ridley's "If ewe bison, ewe kangaroo terrier-bull byte otter it".

More straightforward were M Glass's "It's ears ahead", and from A Patrick, "It provides the missing links to make me a cool Computer cat".

If not, he'll let you go (and of course you can pick up those diamonds he's thrown away)—after

counting the coins in the

store. If there aren't exactly

1000, he'll suspect foul play,

and probably kill you ...

Mrs Allemand struck a suitably aggressive note, worthy of Marvel comics, with "as Catwoman I'd have power over those ZX-81 jokers". E Jupp's entry, however, took a more relaxed line and confided owlishly "I wynx and blynx, but the Lynx thynx".

Our problem setter slipped up with the Telepathic Dangers competition by setting a problem which had not one but two solutions. Two pairs of segments can be discarded from the cube of On'ey: C and E, and B and F. Many of the entries spotted the blunder and gave both correct solutions.

We awarded the £15 book token to P Hoskins, 30 Springfield Park, Holyport, Berkshire.

He enclosed a program for the Spectrum which not only worked out the solutions but plotted the diagrams of the two possible cubes.

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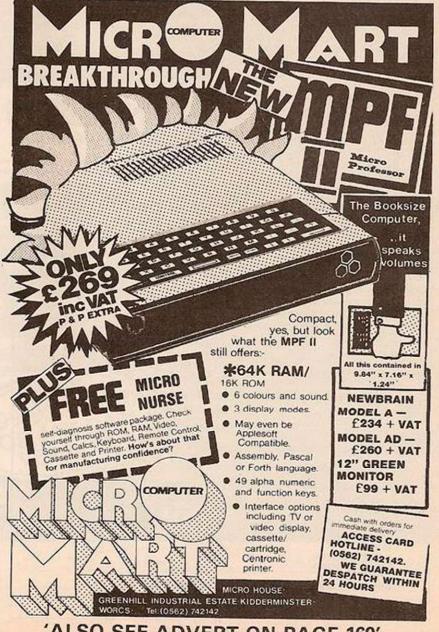
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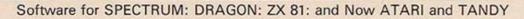
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Availability DRAGON 32: SPECTRUM

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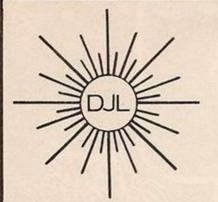
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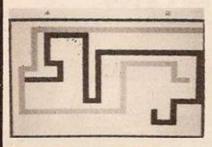
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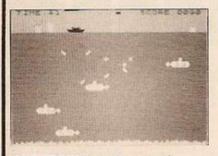


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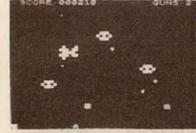
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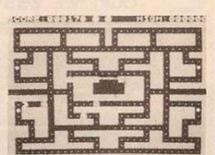
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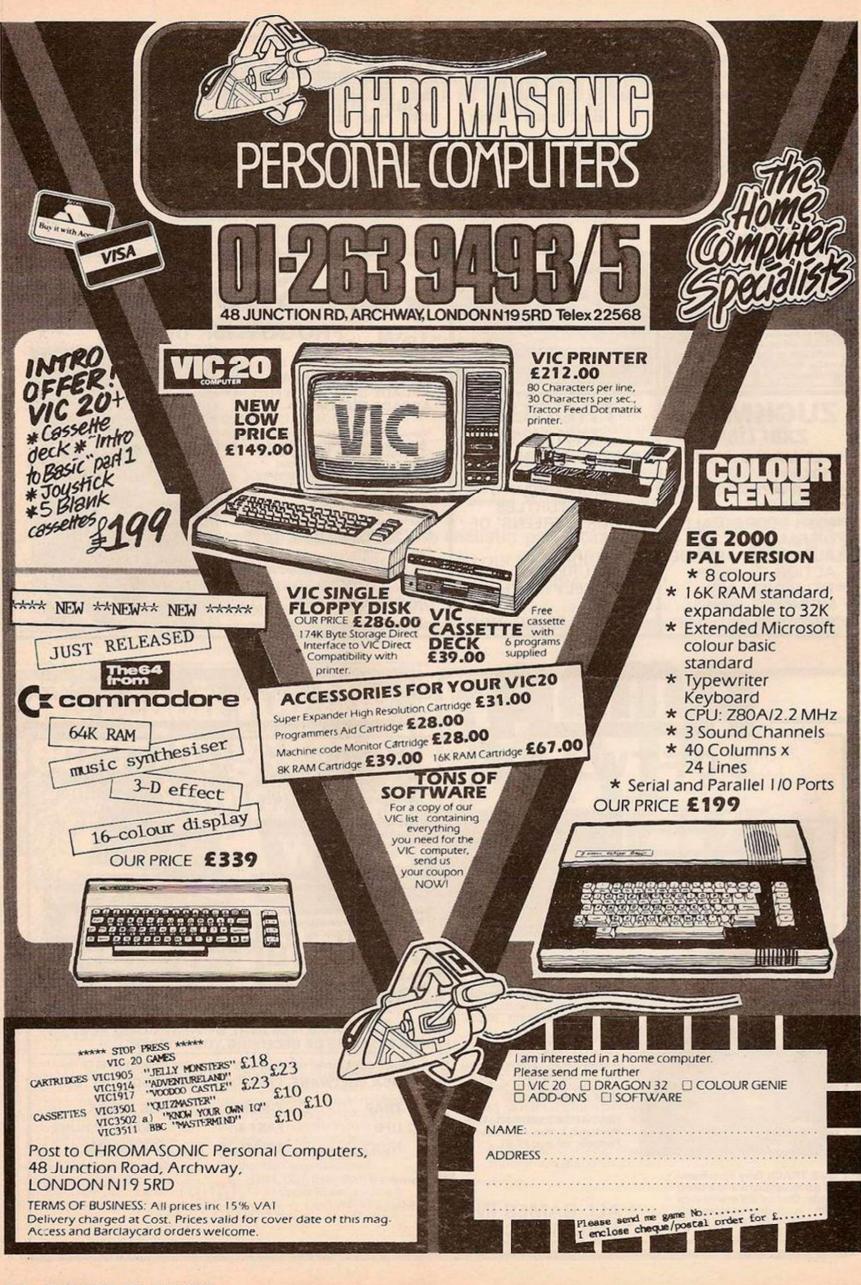
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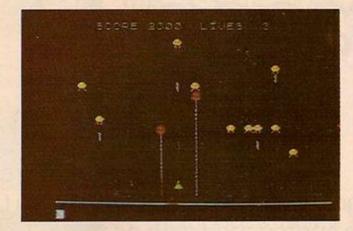
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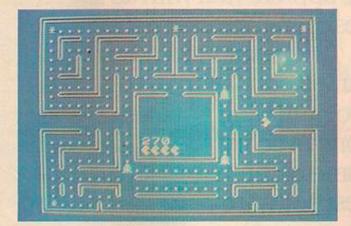


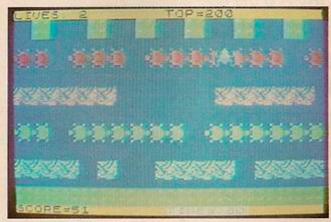
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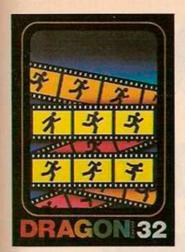
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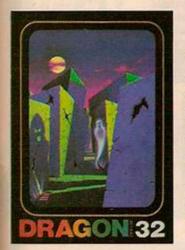




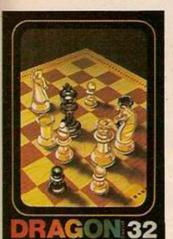
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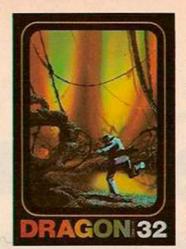
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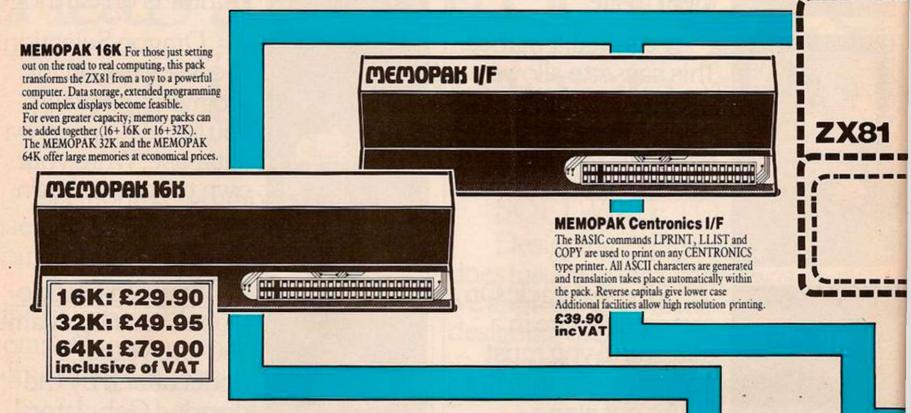
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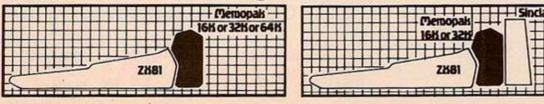
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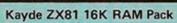
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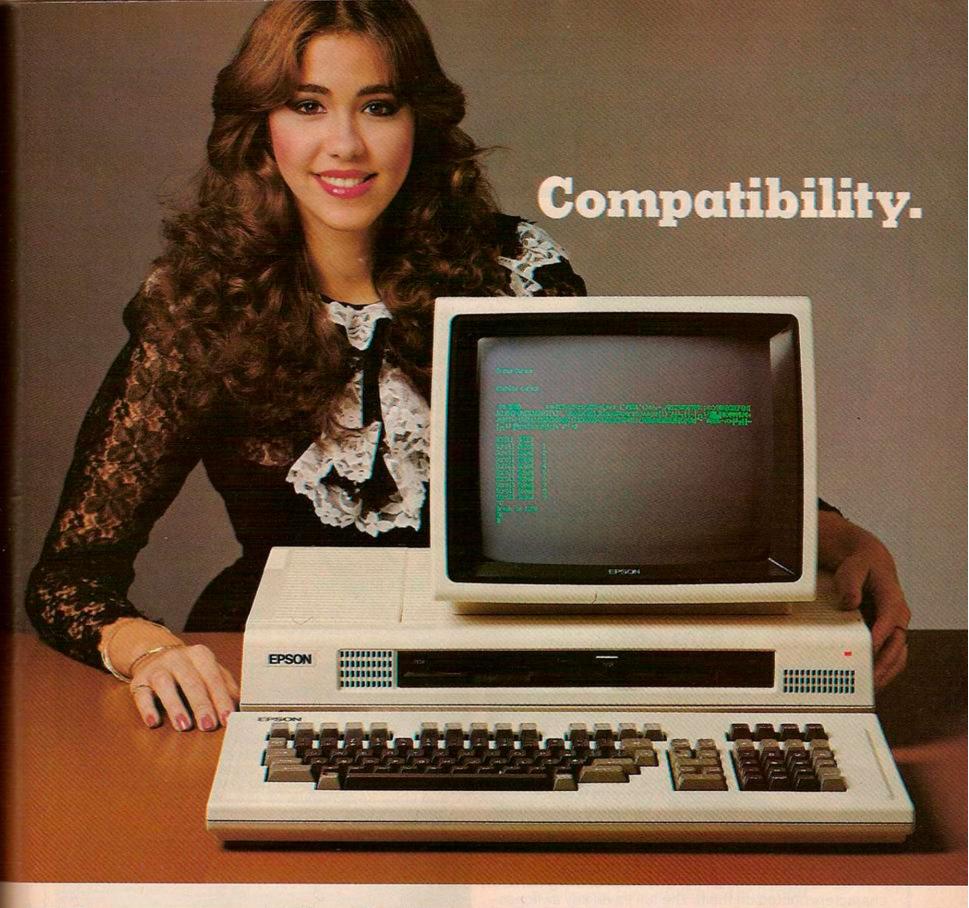
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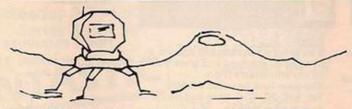
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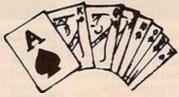
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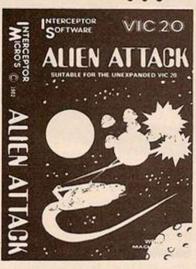
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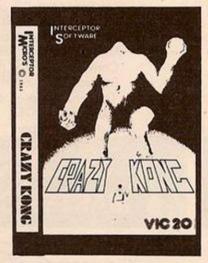
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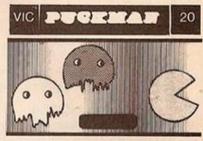
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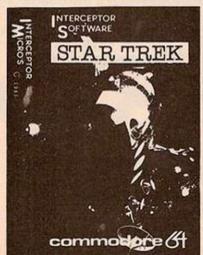


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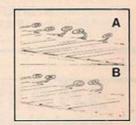
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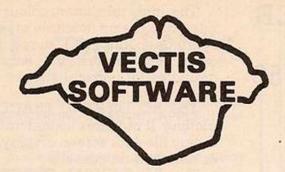
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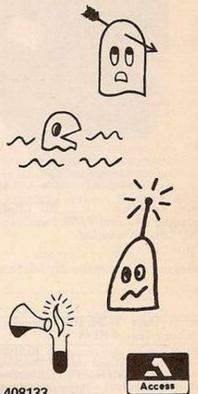
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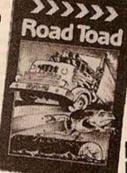


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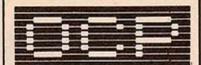
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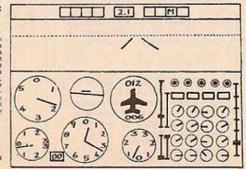
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APPOINTMENTS

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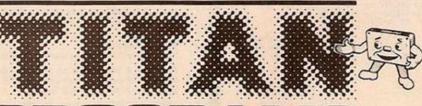
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APPOINTMENTS

Right Now! TITAN are looking for young dynamic and enthusiastic freelance programmers to enhance their already established range of arcade quality software for most types of home computer systems (e.g. Spectrum, Vic, Atari, Oric).

If you feel that you fit these requirements and have a sound knowledge of machine language then waste no more time; write in the strictest confidence to Titan Programs Development Dept., The Computer Palace, 46 Market Place, Chippenham, Wiltshire, SN15 3HU.

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16 K

SPECTRUM 48 K

SERIOUS APPLICATION PROGRAMMES

ELECTRONICS

Ever built a digital electronic circuit that didn't work? Now this highly comprehensive design programme enables you to draw a circuit diagram on the screen, using standard components, including transistors, logic gates, diacs, triacs, thyristors etc etc. (57 defined symbols are used). These may be rotated on screen if required. Once complete the computer will activate the circuit to display the voltage levels throughout. Your circuit may he de-activated, modified and re-activated, saved on tape for future use and copied to the printer. An invaluable aid to the designer of digital electronicircuits, either hobbyist or professional, this programme can cope with circuits from the simplest to a screenful of densly packed interconnected components. ital electronic pe with

NUMERIC

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 It will a. Solve any equation for a single unknown.

 b. Plot the graph of any function you may expand or contract the axes and alter the increments in order to obtain the best representation of your function.

 c. Solve simultaneous and quadratic equations.

 d. Solve right angle triangles.

 e. Find arithmetic mean and standard deviation for a list of numbers.

 It will do the same for two lists plus finding the coefficient of correlation between them. Graphs can be produced for your data against the three Standard Deviation curves.

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ELECTRONICS requires the DK Tronics UDG board to run on a ZX81 but operates on a normal Spectrum. These superb programmes are extremely user friendly, come with comprehensive instructions and offer facilities too numerous to cover in this advertisement. Exceptional value for money.

Please state computer type: Cheques payable to:



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EXCLUSIVE TO GREENWELD

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code routines.

12 titles are available for these computers:

ZX81 (16K); ZX SPECTRUM (16K); BBC 'A' or 'B'. All tapes for any machine are £4.95 each inclusive. Set of 12 £45.00

- MASTERMIND. Try to find a 3 to 7 digit number the computer has selected in less
- BAR CHARTS. Enter information on X & y axis, and see a bar graph drawn of your
- results.
 3. OXO ANAGRAMS. Noughts and crosses game that requires the pupil to solve an
- anagram to gain a 'O' or 'X'.

 4. HANGMAN. Traditional game with 10 categories and 10 words in each category. Different words/categories can easily be entered.

 5. SPELL INVADERS. Shoot at the correct letter in the alphabet to spell the word shown on the screen for a few seconds. lose an 'invader' each time a wrong letter is selected!
- selected!

 6. REACTION TEST. To promote keyboard familiarity give practice in reading decimal
- DEPTH CHARGE. Practice in the use of ordered triple (X, Y, Z) coordinates in 3 D.

- o covers the points of the compass.

 ZIGOL. practice in the use of ordered pair (X,Y) coordinates in 2D.

 GUILLOTINE. French version of hangman, but your head drops into a basket if you
- fail to find the word!

 10. OXO ADDITION & SUBTRACTION. Noughts and crosses game where the pupil solves an addition or subtraction sum to gain a 'X' or 'O'.

 11. OXO MULTIPLICATION & DIVISION. As above but using times and divide.

 12. BEETLE ADD. To get the various parts of the beetle, simple addition sums must be

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A list is available for each make of computer, which contains details of software and

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Fig. 1



Fig. 2

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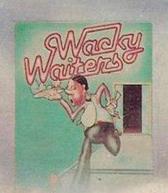
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